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MODERN UROLOGY

IN ORIGINAL CONTRIBUTIONS BY
AMERICAN AUTHORS

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VOLUME I

GENERAL CONSIDERATIONS—DISEASES OF PENIS AND
URETHRA—DISEASES OF SCROTUM AND TESTICLE—
DISEASES OF PROSTATE AND SEMINAL VESICLES

THIRD EDITION THOROUGHLY REVISED

ILLUSTRATED WITH 546 ENGRAVINGS AND 12 PLATES



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DEDICATED
TO THE MEMORY OF
ARTHUR TRACY CABOT

TO WHOSE SKILL AND INTEGRITY AS A SURGEON
AND TO WHOSE WISDOM GENTLENESS AND FORCE OF CHARACTER
I DESIRE TO EXPRESS MY DEBT OF GRATITUDE

PREFACE TO THE THIRD EDITION

TWENTY years have now elapsed since the preface to the first edition of the book was written. At that time it was pointed out that urology in America was a young specialty—not in fact much more than of voting age. In those days urology, then called genito-urinary surgery, was commonly combined with the practice of syphilology. It was at that time suggested that there was no sound basis for this association and that it was to be hoped that the importance of special study of syphilis as well as of urology would result in a separation of these two fields. The result has very largely come to pass much to the benefit of both specialties.

Since it is now twelve years since the last edition appeared, very considerable changes in the list of contributors have been inevitable. The selection has been made in order widely to represent urologic opinion in America. In many of the fields such important changes have taken place that the article had to be entirely rewritten. I think there is reason to believe that the present edition will be at least the equal of its predecessors.

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MODERN UROLOGY

SECTION I

CHAPTER I

THE CYSTOSCOPE AND ITS USE

By WILLIAM BENT M.D., F.A.C.S.

AND

DONALD A. CHARNOCK M.D., F.A.C.S.

THE HISTORY OF THE CYSTOSCOPE

OVER a century and a quarter has passed since the first attempt to visualize the lower urinary tract. In 1803 Bozzani of Frankfort¹ constructed his rather cumbersome apparatus to which he gave the name *Licht Leiter* (Fig. 1). With this Bozzani was able for the first time to visualize the human urethra in the living subject. Such audacity in seeking to bring into view hidden parts of the body met with sufficient opposition to dampen the ardor of the inventor. The medical faculty of Vienna when charged by the Austrian government to investigate this radical instrument augustly announced that it was little more than a toy and seemed to intimate that Bozzani was showing an undue curiosity in attempting to investigate concealed regions of the human anatomy.

Two decades elapsed before the next attempt was made to investigate mechanically the urinary tract. In 1826 Segalas² (Fig. 2) described an instrument which he named the *Speculum Urethro-cystique*. Although any history of the cysto-scope must rightly start with Bozzani Segalas must be credited with constructing the first usable instrument (Fig. 3). His endoscope consisted of a cylindrical tube which was introduced into the urethra. A gum elastic cannula of sufficient size to fill this cylinder was used as an obturator to facilitate the introduction. Once inserted this cannula was removed and a system of mirrors was moved into place which enabled a beam of artificial light supplied by two small tapers to be thrown into the cavity to be examined.

Working at about the same time Dr. John D. Fisher³ of Boston described an instrument which was originally constructed to inspect the vagina (Fig. 4). This Dr. Fisher amplified so that it could be used to inspect the urethra. As early as 1827 Professor R. M. Latterson

Three years later in 1865 two workers in St. Petersburg Courmand⁴ and Evermann employed reflecting mirrors and a separate tube for endoscopic observation. This work attracted little attention but



FIG. 2—Pierre Segal (1799-1871) constructed the first udder endoscope (Encyclopédie Française d'Urologie courtesy of G. Dolin et Cie)

certainly antedates by many years the open air endoscopic technique described by Lawlik (Fig. 6) and by Kelly. In the same year Cruise⁵ of Dublin described his results using an instrument which was identical in principle with that of Lister of Boston. The contribution which Cruise made was in intensifying his light (Fig. 7). He used

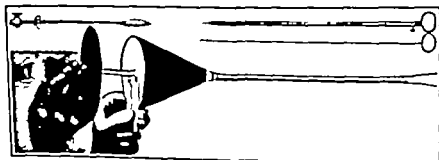


FIG. 3—Regulus endoscope (Encyclopédie Française d'Urologie courtesy of G. Dolin et Cie)

an oil flame fortified with camphor which produced a greater illuminating intensity. With this instrument he distended the bladder with water for examination using a glass window at the end of the tube for

of Boston suggested the use of galvanism as a means of illuminating dark cavities through Fisher's tube. This suggestion was tried but never proved successful.

The next two decades were devoid of any advance in urinary tract instrumentation and it was not until 1853 that Desormeaux⁴ presented to the Academy of Medicine of Paris the first serviceable endoscope. This consisted of a tube into which rays of light were reflected by means

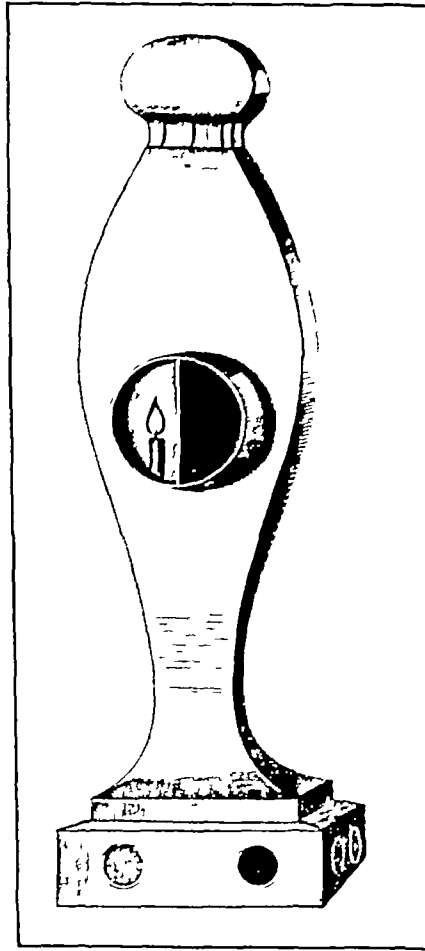


FIG 1 —Bozzani's "Licht Leiter" (After Bozzani)

of mirrors, the source of which was a kerosene lamp (Fig 5). With this, the inventor carried out numerous investigations over a period of years. It is on this instrument that the French school claims priority in the invention of the first practical means for examining the bladder.

In 1862 Haken⁵ of Vienna introduced an instrument for dilating the urethra not unlike the Kollman Dilator which is in use today. The hollow central portion of this instrument allowed inspection of the urethra with the aid of a concave mirror for introduction of light.

vision. Cruise was enabled to get superior results by his more efficient illumination. Illumination was increased in 1867 when Andrews introduced the idea of burning a piece of magnesium wire in a kerosene flame which to use Andrews' words "burns with a white light whose brilliancy dazzle like the glare of the sun at noonday" and makes the urethra as plain as though it had been dissected and laid in the sunlight. Andrews very ingeniously developed a spring wheel mechanism to automatically feed the magnesium into the flame.

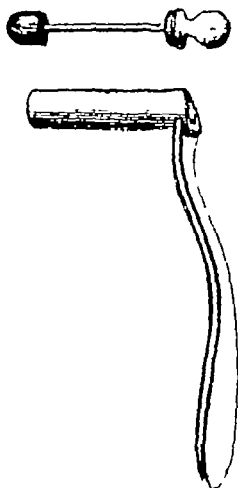


Fig. 11. — The open air endoscope constructed by P. Wink. (Arch. f. Klinische Chirurgie.)

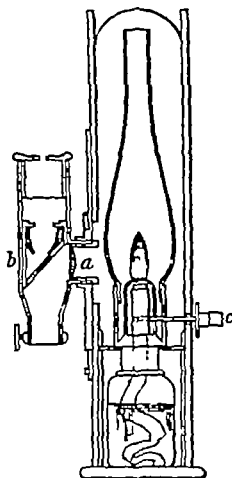


Fig. 11. — The lighting arrangement devised by Cruise. (Cruise, Dublin Jour. Med. Sci.)

Chief among the workers with the endoscope type of instrument was Grünfeld⁹ of Germany, who carried out successfully many procedures including the first successful attempt at catheterization of the ureter done in 1874. Klotz¹⁰ in New York introduced an endoscope with a fenestrum which could be closed with an obturator during introduction. Both Klotz and Grünfeld were able to carry out numerous operative procedures with the endoscopic instrument.

The year 1867 closes the early era of visual instrumentation in which the light was directed from the outside through a system of mirrors

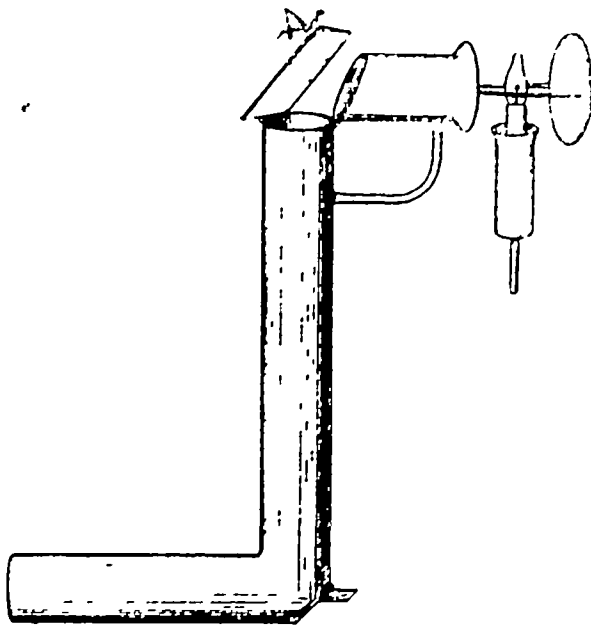


FIG 4 —The first urethroscope made in America by Fisher (Jour Phila Med and Phys Soc , 1827)

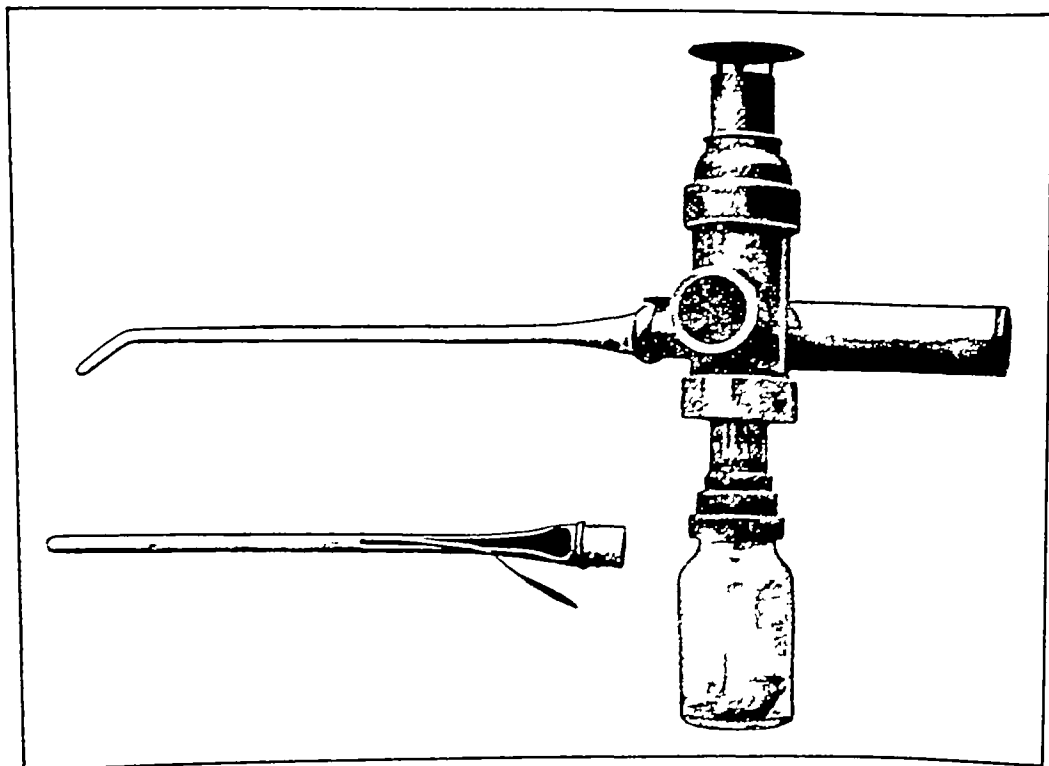


FIG 5 - The original instrument constructed by Desormeaux (Encyclopédia Française d'Urologie courtesy of G. Doin et Cie)

Nitze brought to Vienna was really a catheter made of metal and bent at an angle. A lighting unit was passed down through the tube. This consisted of a platinum loop sheathed in a goose quill and cooled with a continuous stream of water. Materially aided by the mechanical ability of Leiter this soon took on the form of a practical instrument and models were offered for sale in a catalogue published in Vienna in 1880¹² (Fig. 10).

In 1880 the incandescent lamp was invented by Thomas Alva Edison (Fig. 11) but this new means of illumination was not immediately applied to instruments and three years elapsed before a cysto-



Fig. 11. Max Nitze who constructed the first optical cystoscope. (Compare Han Hirschler Cystoscope 1885, courtesy of Georg Thieme.)

scope was described using the electric lamp. In 1883 Newman¹³ of Glasgow described an instrument in which the incandescent lamp furnished the illumination (Fig. 12). Newman powered this light with two cells which gave an illumination equal to about one candle. This light was placed within a speculum and introduced within the bladder. Newman's instrument was limited to the female but with it he was able to carry out numerous procedures and recognized many bladder lesions.

In March of 1883 the brilliant Frenchman Boisseau du Rocher¹⁴ first presented his incandescent lamp cystoscope of indirect view and megascopic optical arrangement. In 1887 both Nitze and Leiter

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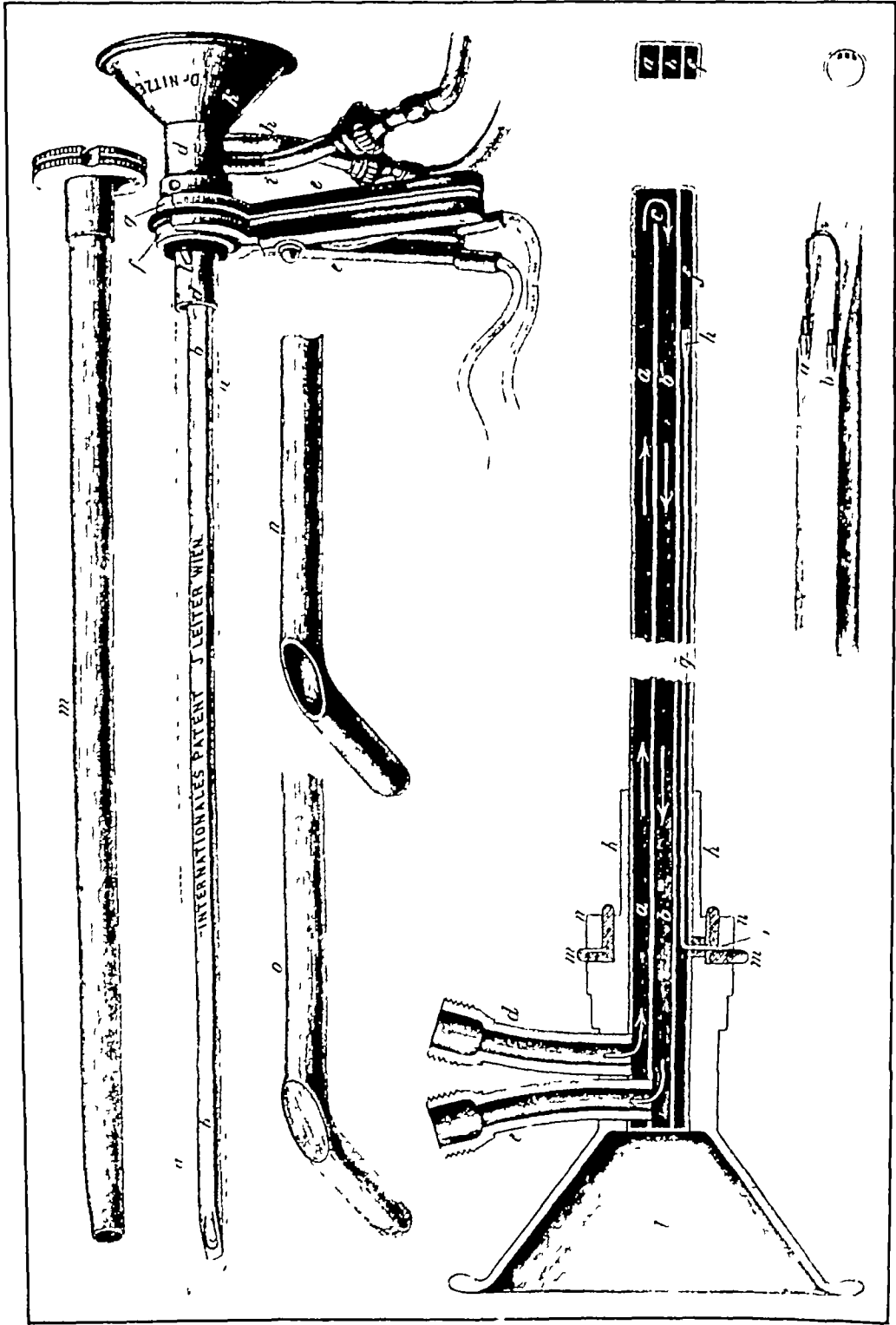
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FIG. 9—Max Nitze who constructed the first optical cystoscope. (Casper's *Handbuch der Cystoskopie* 1898, courtesy of Georg Thieme.)

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now working independently presented their first cystoscope illuminated with an incandescent lamp. These three instruments formed the



FIG. 11 — Thomas Alva Edison invented the incandescent lamp in 1880

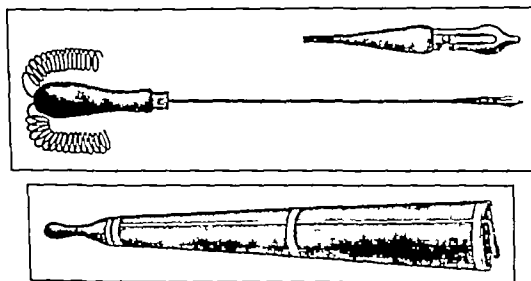


FIG. 12 — The first instrument illuminated by an incandescent globe made by Newman in 1883. (Glasgow Med. Jour.)

basis on which all later cystoscopes have been modeled and marks the practical accomplishment of the task so long and diligently sought

by investigators preceding them. In 1887 Dittel¹⁶ placed the light at the tip of the beak of the cystoscope (Fig. 13).

Nitze's instruments were built in two models: one with a prism for indirect or right angled view and the other for direct view. Both of them were illuminated with the light at the beak. In 1889 Brenner modified the direct view instruments by building a small canal through the lower wall, primarily for the purpose of furnishing a mode of exchanging the fluid in the bladder during observation but which later

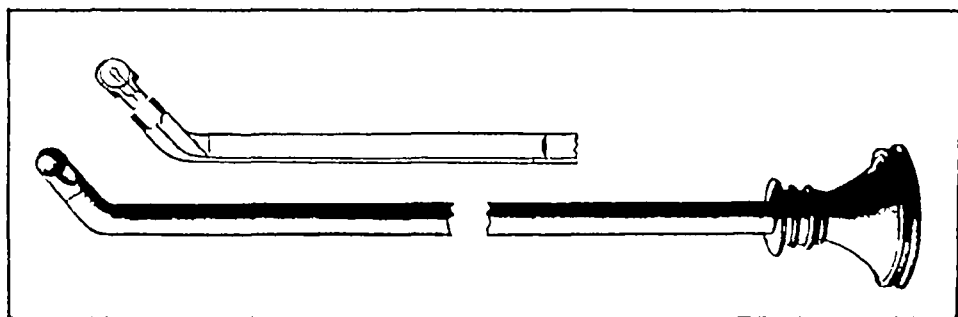


FIG. 13 — Dittel's instrument with the lamp placed at the beak of the instrument (Caspar, *Handbuch d. Cystoskopie*, courtesy of Georg Thieme)

was used for the introduction of a ureteral catheter.¹⁷ This instrument carried only a single catheter and employed a direct view lens system (Fig. 14).

In 1889 Boisseau du Rocher presented for practical use the instrument upon which he had been working for four years (Fig. 15). That this cystoscope did not attain immediate recognition in America is best explained by the fact that American medicine was at this period more influenced by the German school than by the French. Boisseau's

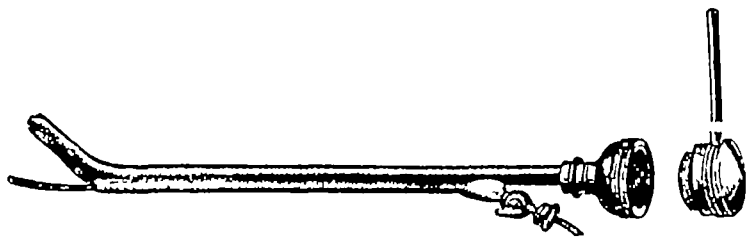


FIG. 14 — Brenner's cystoscope with the first ureteral catheter tunnel

instrument was the first to deviate from the usual form of a fixed lens system of the Nitze and Leiter type, in which the optical system was made integral with the sheath of the instrument. Boisseau separated the ocular part from the sheath and lamp-carrying beak, presenting the service sheath with illuminated beak as one part and various types of telescopes as the other, these latter being fitted into the sheath at will. This was an achievement of greatest importance, permitting latitude of intravesical observation and manipulation impossible with

instruments of the fixed lens type. The fact that the instruments of today are almost without exception based upon this principle of Boisseau du Rocher bears out his contention that now for the first time cystoscopic instruments were placed upon a definite workable basis. In addition to this pioneer achievement in inventing the separate sheath and telescope instrument Boisseau du Rocher supplied in the same instrument for the first time means for catheterizing both ureters by building two catheter channels into the lower wall of the sheath. This was the first instance in which synchronous double ureteral catheterization was possible. Boisseau du Rocher's instrument of 1889 was built in two forms. One sheath was equipped with fenestration and illumination on the convex aspect adopting the direct mode of observation and catheterization while the second sheath was fenestrated and illuminated on the concavity. Later in 1898 the instrument was modified by double fenestration of a single sheath. This allowed observation on both concavity and convexity multiple telescopes being passed through one sheath for this purpose. The first use of the Boisseau du Rocher instrument for bilateral catheterization was reported by Poirer¹³ who on August 2, 1889, successfully catheterized both ureters in the living subject.

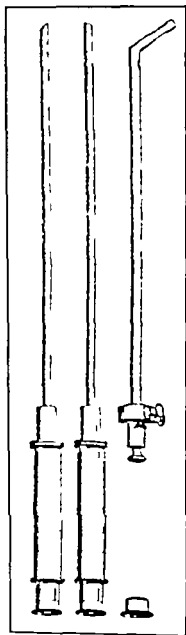


FIG. 15.—Boisseau du Rocher's instrument in which for the first time the lenses were separated from the sheath (Ann d Maladies Organes).

During the remainder of the nineteenth century numerous changes were made in the various instruments presented. Their inventors employed individual features that seemed advantageous with respect to the setting of the lenses, mode of accomplishing irrigation, etc. but none presented any marks of originality or definite departures from the principles already conceived by Nitze and Boisseau du Rocher. In 1897¹⁴ Albarran placed a movable lever for controlling the ureteral catheters upon his instrument. This marks the first time that the so-called lid lift was made use of in a catheterizing instrument (Fig. 16).

The beginning of the twentieth century finds American workers becoming interested in development of the cystoscope. Although

American workers had several times described instruments of the endoscopic type, cystoscopic instruments were still being supplied exclusively by the European manufacturers. Chief among those describing an endoscopic instrument was Howard Kelly²⁰ who, in 1893, brought out his direct view endoscope. By distending the bladder with

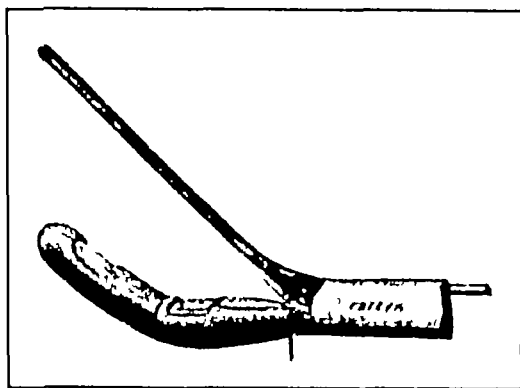


FIG. 16 — Albarran's lever for "lifting" the ureteral catheter (Revue de Gynécologie de Pozzi)

air, he was successful in catheterizing ureters and carrying out intra-vesical operation. This instrument, similar to the one designed by Pawlik²¹ obtained illumination from external sources and was only practicable for use in the female.

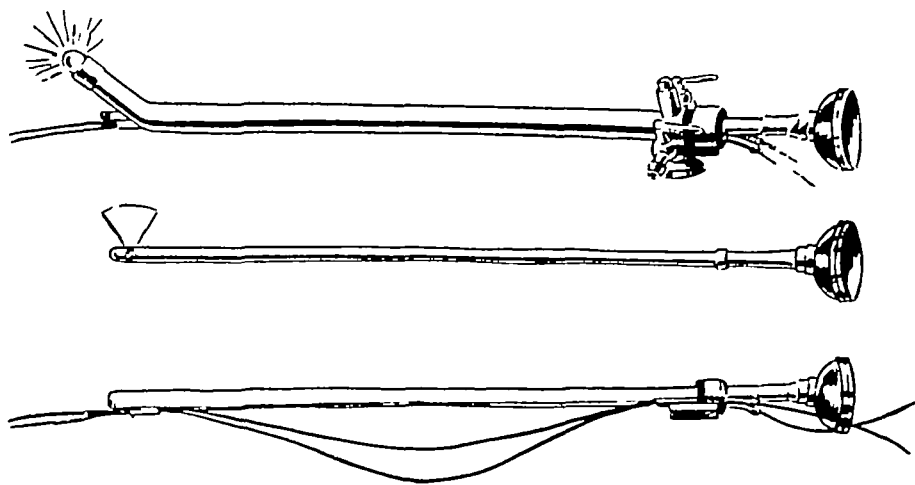


FIG. 17 — The first instrument devised by Tilden Brown, 1889 (Lewis, Transactions of the Am. Urological Assn., 1908)

In 1889²² Tilden Brown of New York developed an instrument made for him in Vienna by Leiter. This was modified from the old Brenner instrument but with it Brown was later able to fix two catheterizing channels for double ureteral catheterization (Fig. 17). Up to the beginning of this century no attempt had been made by American

manufacturers to produce a cystoscope in this country. William K. Otis²⁷ of New York was the first American worker to encourage the manufacture of an American instrument. He did this because of the difficulty in obtaining and especially in repairing European instruments. Here again we find the surgeon-inventor seeking the aid of a skillful instrument maker. It was at this time that Otis took his troubles to Reinhold Wappler, who was engaged in the manufacture of medical electrical instruments. Together they began a series of experiments in an attempt to develop the possibilities of the cystoscope and in 1900 Otis was able to present before the American Association of Genito-urinary Surgeons in Washington the first electro-cystoscope manufactured in America.⁴

Most important of the instruments of that day was that of F. Tilden Brown for many years designated as the Otis-Brown instrument. Brown really deserves credit for the first all American instrument as Otis' purpose had not been so much to produce something different from those being manufactured in Europe as to encourage the construction of cystoscopes at home. Wappler revolutionized the lens system and a few years later Leo Berger³ still further modified and improved the earlier production of Otis and Brown by changing the image from an inverted to an upright one so that the resulting combination has since been known as the Brown-Berger cystoscope.

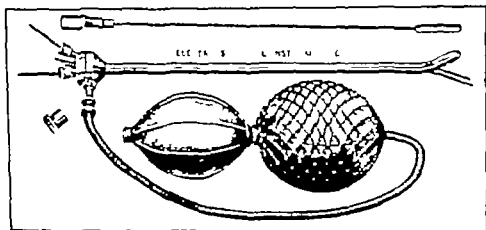


FIG. 15 - Bransford Lewis direct view air-cystoscope

In 1900 Bransford Lewis presented a direct view air cystoscope.²⁸ It differed from Pawlik-Kelly instruments and methods in that internal illumination was supplied by a Charles Preston cold electric lamp placed in the convexity of the beak. Air distention of the bladder was obtained by rubber bulb pressure. This released the surgeon from dependence on the objectionable knee-chest position of Pawlik and Kelly and made the instrument useful for both male and female. Because of its simplicity and small cost this air-cystoscope of Lewis popularized the practice of cystoscopy with the general profession and also advanced the cause of ureteral catheterization by its directness.

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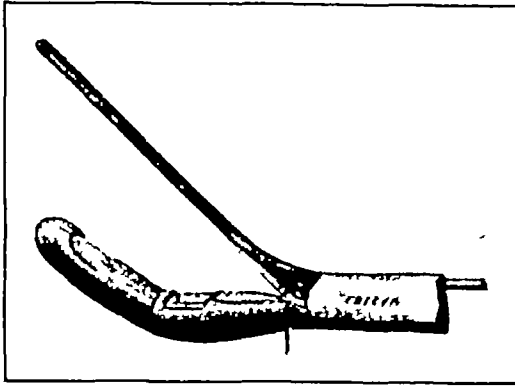


FIG 16 —Albarran's lever for "lifting" the ureteral catheter (Revue de Gynécologie de Pozzi)

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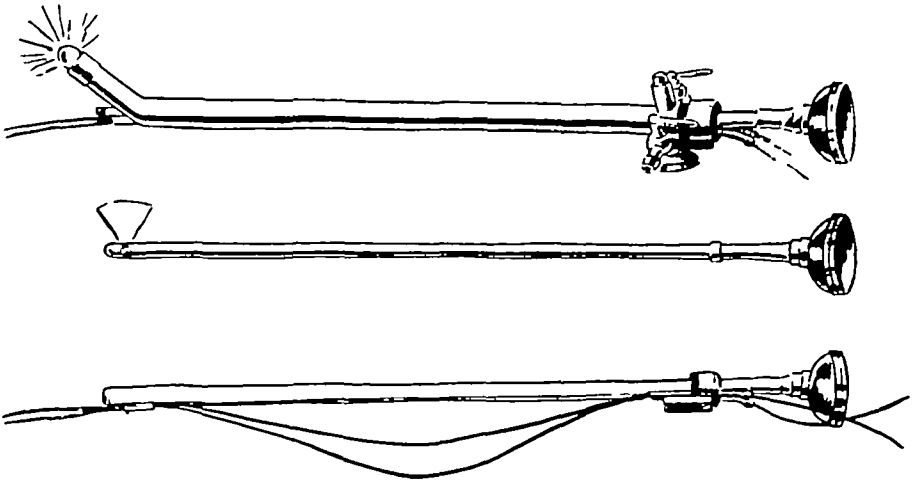


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It must not be supposed from this statement that the European manufacturers had fallen far behind in producing workable instruments. The skill of the English, French and German urologists together with the ingenuity of instrument makers in these countries had produced a formidable array of satisfactory cystoscopes. The principles involved in their design do not differ materially from the instruments available in this country.

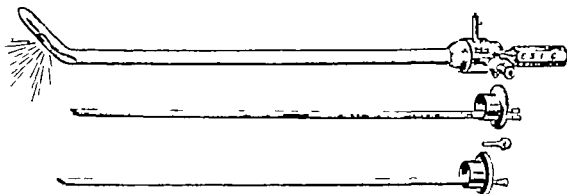


FIG. 20.—Branch cystoscope. (Electro-Surgical Instrument Company, Rochester, N. Y.)

Though not so popular as the telescopic type of instrument, the endoscopic tube equipped with electric lighting is quite widely employed and the many designs serve a useful purpose in the instrumental equipment of today. To the dextrous and well-trained operator the larger tube gives room for a more extensive procedure. The endoscope of Luys²⁴ has been widely employed in France and the rest of Europe. This has been modified by American workers, notably McCarthy. A similar endoscopic device was originated by Elsner in this country and later modified and amplified by the Electro-Surgical Instrument Company for Branch. It is now generally known as the Branch Cystoscope (fig. 20). Distention of the bladder is obtained by the introduction of water, which makes the cystoscope available for use in both sexes. A small glass window closes the ocular end and when used in a water medium direct view is obtained without the intervention of any lenses; the observer looking through the window down the water-filled sheath. Ureteral catheters may be passed through

of view and ease of manipulation (Fig 18) Moreover, it paved the way for the development and introduction by Lewis, in 1904, of his operating cystoscope, which embodied the first formulated cystoscopic equipment of forceps, dilators, scissors, knife and other accessories for operative work within the bladder—a pioneer step that was quickly grasped and utilized by urologists and broadened tremendously the field of operating in the bladder

In 1906 Lewis introduced the first model of his Universal cystoscope, of the sheath-and-telescope type, with American-made lenses providing for water distention and views forward, backward and at an angle, affording synchronous double ureteral catheterization either by the direct or indirect method, the complete illumination supplied by double fenestration of the beak, after the plan originated by Boisseau du Rocher, whose instruments up to that time had never been given the recognition and acclaim that they deserved Lewis' "Universal instrument" was fitted with a removable fin to be replaced with a third channel for the passage of the several accessory instruments for operating in the ureter, so that, embracing every faculty of cystoscopy, its author considered the name "Universal" as well justified

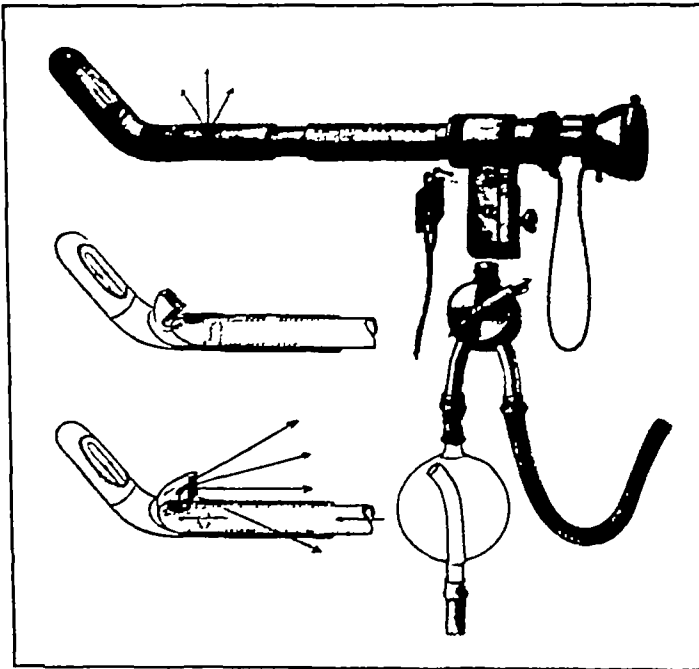


FIG 19 —Schlagentweit's articulated retrograde lens (Centralblatt f Harn u Sexual Organe)

In 1903 Schlagentweit²⁷ developed an instrument for retrograde use By the use of an articulated lens system, he was able to change a right angle view instrument into a full retrograde instrument (Fig 19) This valuable innovation has been modified by several later worker, including Bransford Lewis and Hugh Young

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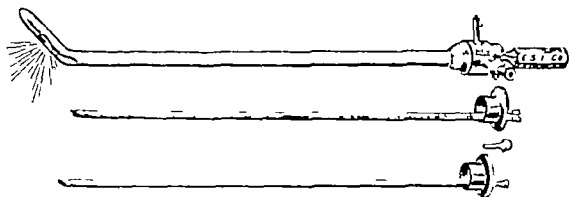


FIG. 20.—Braasch cystoscope. (Electro-Surgical Instrument Company, Rochester, N. Y.)

Though not so popular as the telescopic type of instrument, the endoscopic tube equipped with electric lighting is quite widely employed and the many designs serve a useful purpose in the instrumental equipment of today. To the dextrous and well-trained operator, the larger tube gives room for a more extensive procedure. The endoscope of Luvy³⁰ has been widely employed in France and the rest of Europe. This has been modified by American workers, notably McCarthy. A similar endoscopic device was originated by Isner in this country and later modified and amplified by the Electro-Surgical Instrument Company for Braasch. It is now generally known as the Braasch Cystoscope (Fig. 20). Distention of the bladder is obtained by the introduction of water, which makes the cystoscope available for use in both sexes. A small glass window closes the ocular end and when used in a water medium, direct view is obtained without the intervention of any lenses, the observer looking through the window down the water-filled sheath. Ureteral catheters may be passed through

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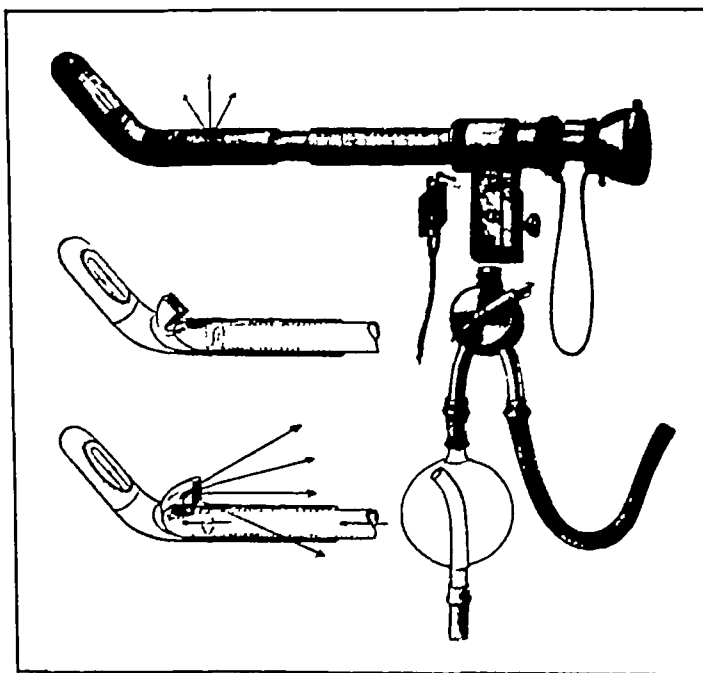


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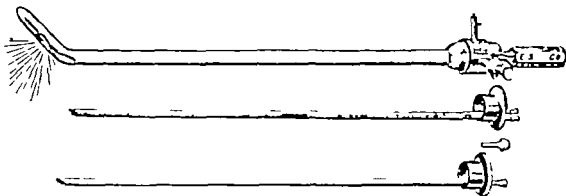


FIG 20—Bransch cystoscope (Electro Surgical Instrument Company Rochester N Y)

Though not so popular as the telescopic type of instrument the endoscopic tube equipped with electric lighting is quite widely employed and the many designs serve a useful purpose in the instrumental equipment of today. To the dextrous and well-trained operator the larger tube gives room for a more extensive procedure. The endoscope of Luvy²⁶ has been widely employed in France and the rest of Europe. This has been modified by American workers notably McCarthy. A similar endoscopic device was originated by Elsner in this country and later modified and amplified by the Electro Surgical Instrument Company for Bransch. It is now generally known as the Bransch Cystoscope (Fig 20). Distention of the bladder is obtained by the introduction of water which makes the cystoscope available for use in both sexes. A small glass window closes the ocular end and when used in a water medium direct view is obtained without the intervention of any lenses the observer looking through the window down the water filled sheath. Ureteral catheters may be passed through

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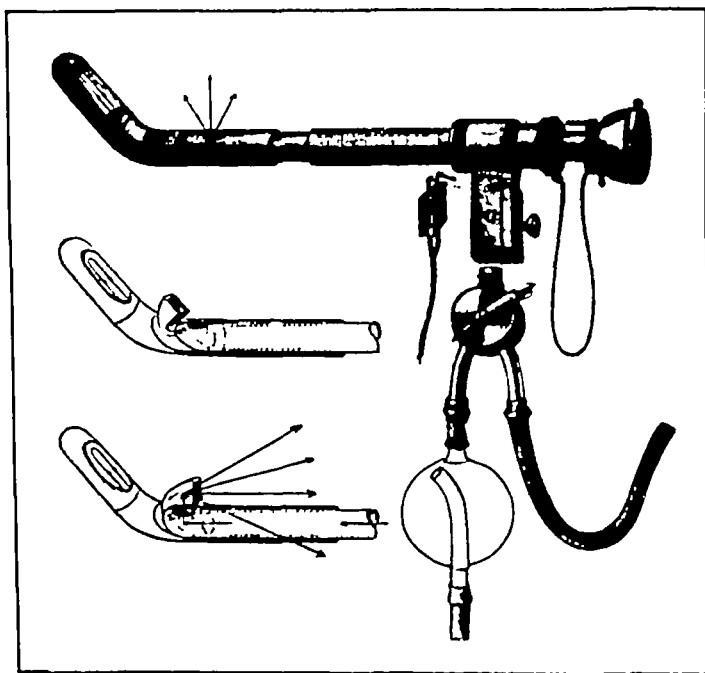


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by the negative pressure obtained by placing the patient in a knee-chest position. To this group must be added the Brausch instrument in which distention of the bladder is obtained by the introduction of water.

The simple endoscopic tube may be lighted either with a reflected beam from a head mirror or from a small lamp attached to the eye end of the tube or carried inward on a small light carrier. Small magnifying lenses may be attached to increase vision. These instruments find their greatest field of usefulness in examining the urethra. In the hands of one trained in their use, very rapid ureteral catheterization can be made in the female. Larger dilating ureteral catheters can be passed through this instrument than through any other type. The field of vision of the non-telescopic instrument is illustrated by Fig. 22. When introduced into the bladder, such an instrument will look directly at the posterior wall. It is necessary to make wide excursions with the instrument to inspect the interior of the bladder. Although

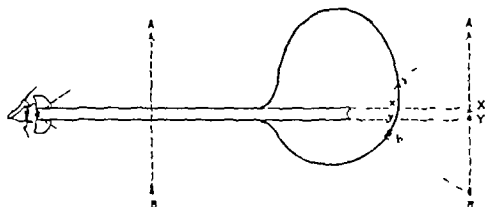


FIG. 22.—Comparison of actual field inspected with a simple endoscopic tube ($xy = 1 \times 1$) and with a direct telescope ($ab = 1 \times 1$)

this is feasible in the female, it is almost impossible to make adequate excursions in the case of the male. These necessary excursions are graphically illustrated by Fig. 23 which accompanies Kelly's description of the instrument.

Telescopic Instruments—The telescopic instruments are grouped according to the optical system employed into (a) the direct cystoscope and (b) the indirect cystoscope.

(a) The *direct cystoscope* is a straight tube containing an optical system by means of which a comparatively large portion of the bladder interior can be visualized, the field of view being many times greater than that obtainable with the endoscope. The optical system is divided into three essential portions: One, an objective lens or lenses; two, a middle or inverting lens or lenses; three, an ocular or eyepiece. The chief physical properties of such a system are the amplification of the field of vision, the correction of the field of vision to an upright position and the magnification of the object to be viewed. This sys-

special channels, no deflector being necessary. Because of the restricted field of vision and the wide excursion necessary to bring the bladder interior into view, the instrument is not in general use. However, in the hands of an operator trained in its use, it has proved very satisfactory.

CLASSIFICATION OF CYSTOSCOPES.

The array of instruments manufactured in this country may be divided into two general groups. One, the non-telescopic instruments and two, the telescopic instruments.

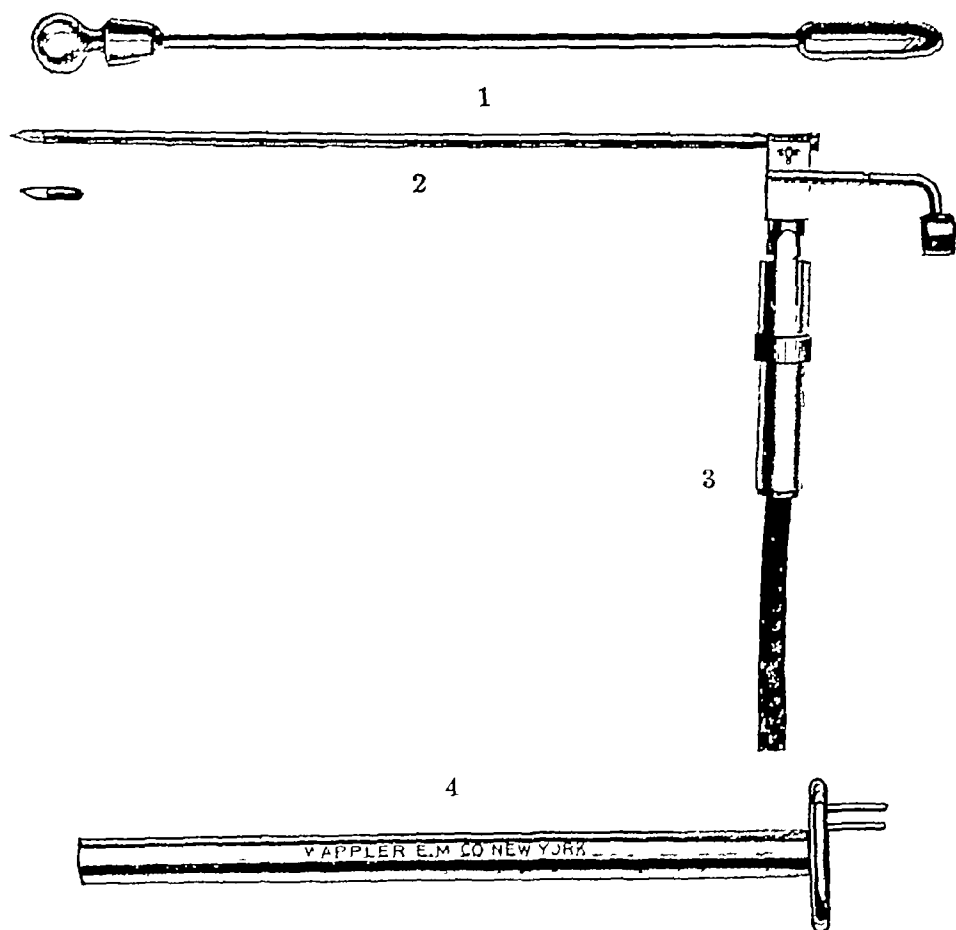


FIG. 21 —Urethroscope for viewing the anterior urethra. 1, obturator, 2, light carrier with small lens attached. 3, electric coupling and cable, 4, endoscopic tube.

Non-telescopic Instruments —The non-telescopic instruments are based upon the principle of direct vision through a simple tube without magnification by lenses. The earlier group of instruments all fell into this class. The present-day endoscopes and urethroscopes such as those described by Pawlik, Kelly, Valentine, Luys and others, are examples of this group (Fig. 21). These instruments depend for distention of the bladder upon air, introduced either by insufflation or

tem is illustrated by Fig 24 The objective is a lens of very short focal distance, which produces a minute, real and inverted image of a comparatively large field at the distal end of the tube This im

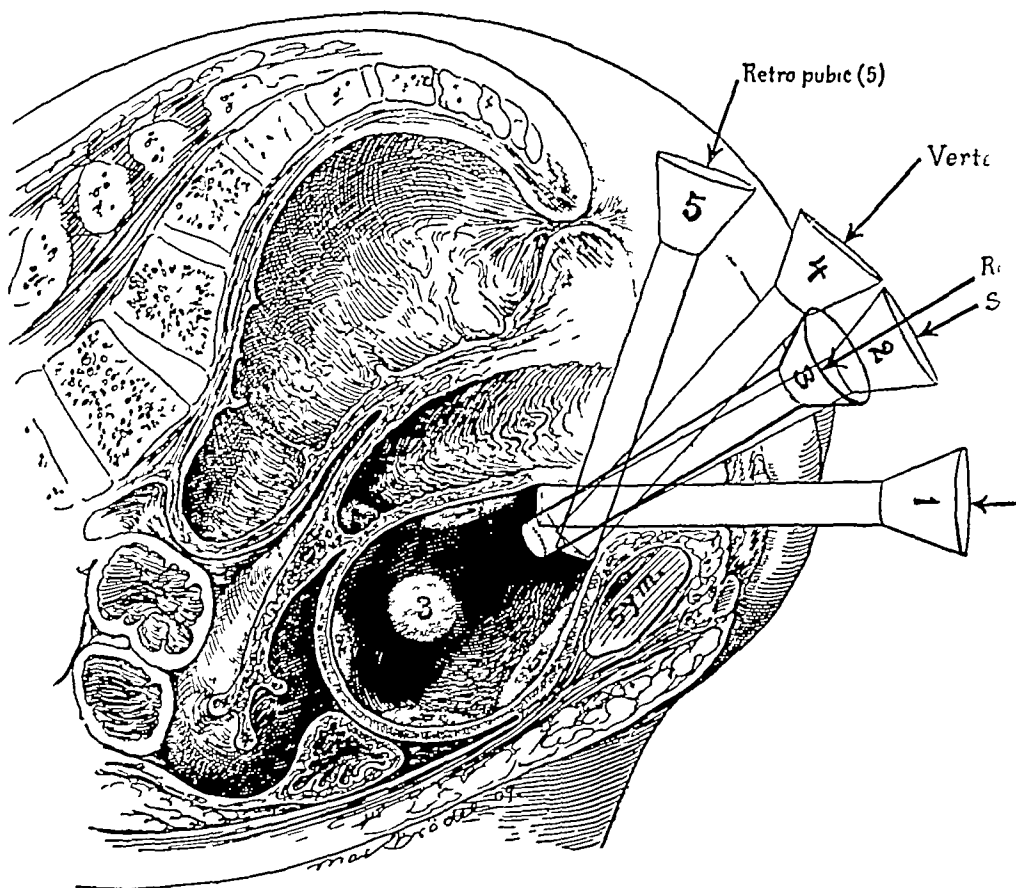


FIG 23 —The position of the Kelly endoscope in viewing the bladder (After and Burnam)

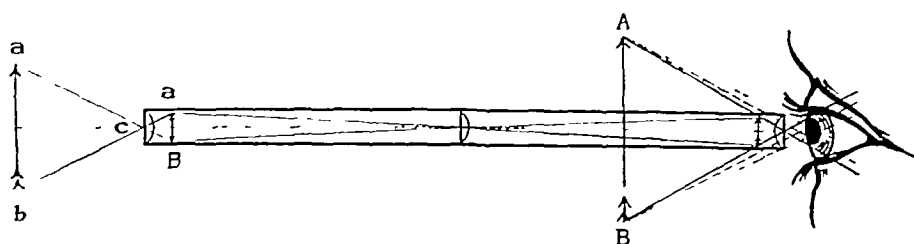


FIG 24 —Direct telescopic system The outer field *a b*, is transferred by the objective lens into a small inverted virtual image *a B* This, in turn, is reversed by the middle lens to the upright position This small image is enlarged by the ocular lens into the inner field *A B*

which is too small to be seen by the naked eye, is transferred by the middle lens to the eyepiece, or ocular end of the telescope, where it is enlarged by the ocular lens The eye sees an enlarged virtual image,

north and south poles are upright and correct and whose east and west points are reversed. The interchange of these points is then brought about by a simple reversing prism of 90 degrees which is placed in front of the ocular. This arrangement gives a larger field of vision and a great deal more light than is obtainable in any other telescopic system. It is generally known as the Wappler Brilliant Lens System.

The indirect telescope is not open to the objection that hampers the other type of instrument. By rotation about its long axis an annular band including roof, lateral walls and floor of the bladder can be seen. By an inward or outward movement along its long axis, called translation, combined with rotation, almost the whole of the bladder interior can be inspected (Fig. 31).

With the optical system of the indirect cystoscope satisfactorily established, the next step was to develop a variety of telescopes appli-

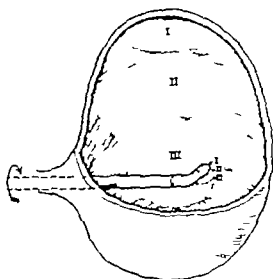


Fig. 31 — Annular band around the whole bladder brought into view by rotation of the prismatic cystoscope on its long axis; very slight rotation bringing the fields I, II and III into view.

cable for specialized work. The most widely used telescope is the one which gives a right angle vision as illustrated in *A* and *B* of Fig. 32. By a slight change in the angle of the objective, a forward looking telescope is constructed as is illustrated in *D*. By far the most popular arrangement for this type was developed for the McCarthy Foroblique pan-endoscope (Fig. 33). Recognizing the advantages of a retrograde lens, several forms of a retrograde system have found their way into the market. The fixed retrograde lens was found to be the most satisfactory as it eliminated the mechanism necessary for articulation as was developed by Schladentweit.

The indirect cystoscope is built with both concave and convex sheaths. In the concave type (Fig. 34) the lamp is placed on the concave side of the tip, the fenestrum being on the same side. The convex sheath (Fig. 35) has the fenestrum and lens upon the convex side.

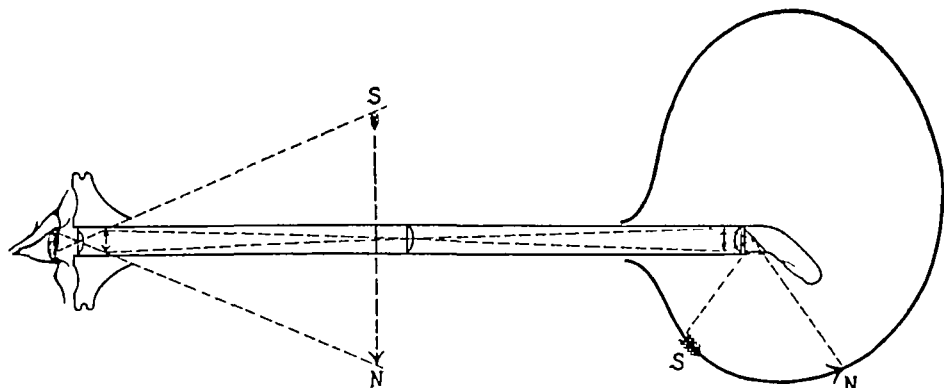


FIG 26 —Nitze cystoscope in longitudinal section viewing the arrow in the floor of the bladder, the picture seen by the eye being inverted

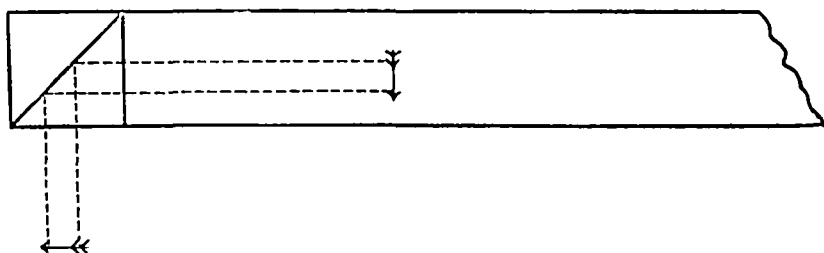


FIG 27 —The effect of the right-angled prism in inverting the points of the field

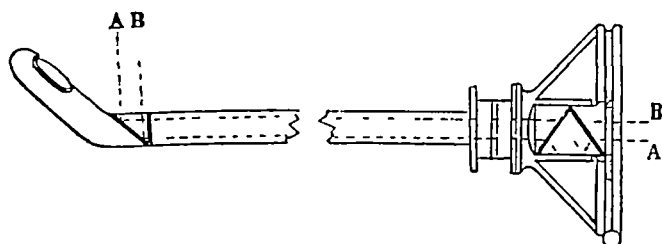


FIG 28 —Frank's instrument with a prism in the ocular to give a correct image (Cystoscope und Urethroskopie Biemweike, Richard Knorr)

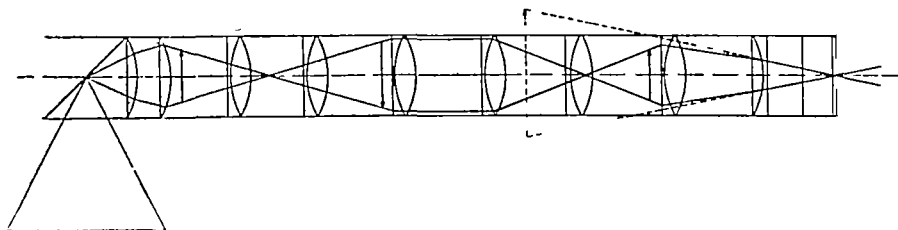
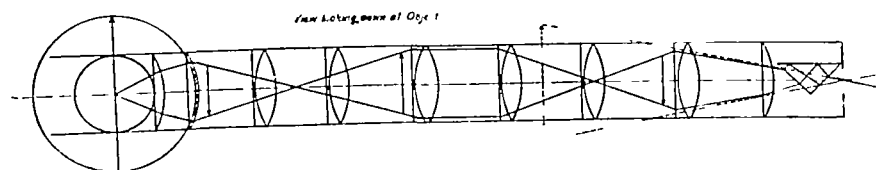


FIG 29 —The course of the rays from north and south points through the corrected lens system, showing four reversals of the arrow, the result being an upright picture (After Berger)



The Wappler "Brilliant Lens System"

FIG 30 —The course of the rays in the same telescope from east and west, showing three reversals through lenses, one reversal by the prism, the final result being non-inversion

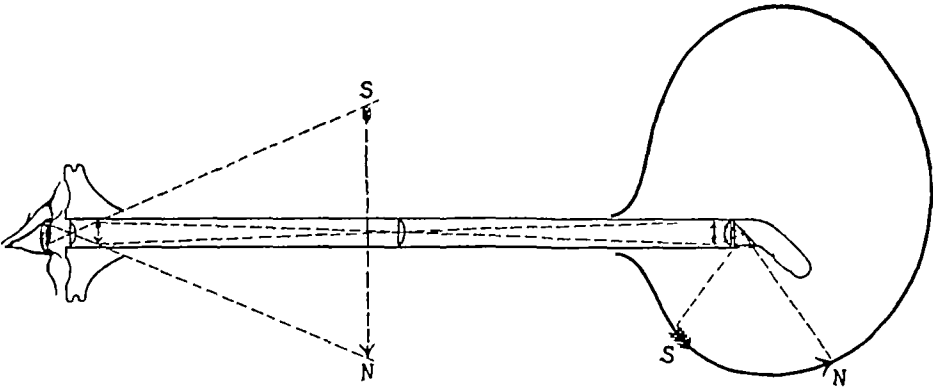


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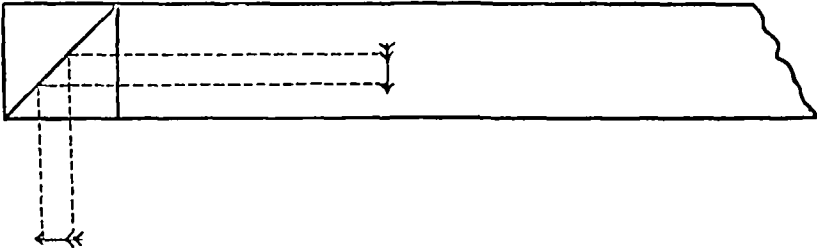


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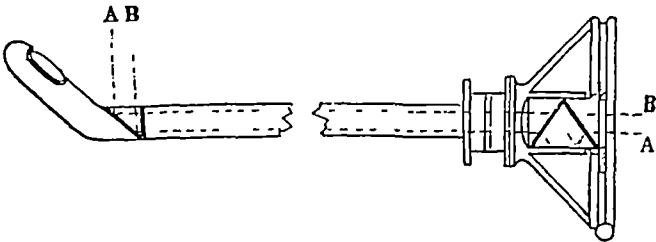


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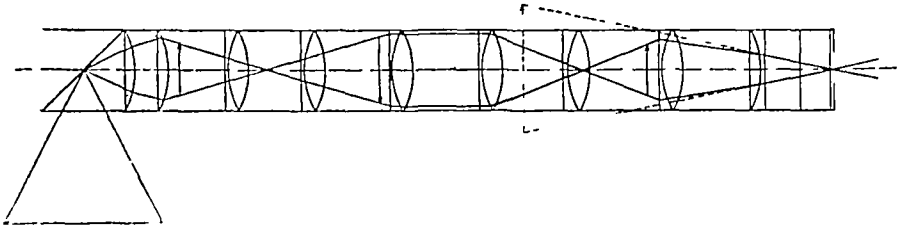
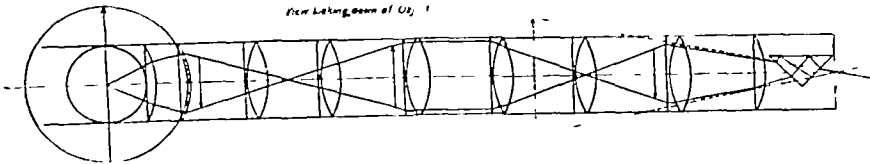


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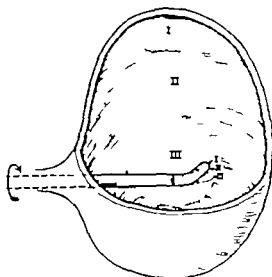


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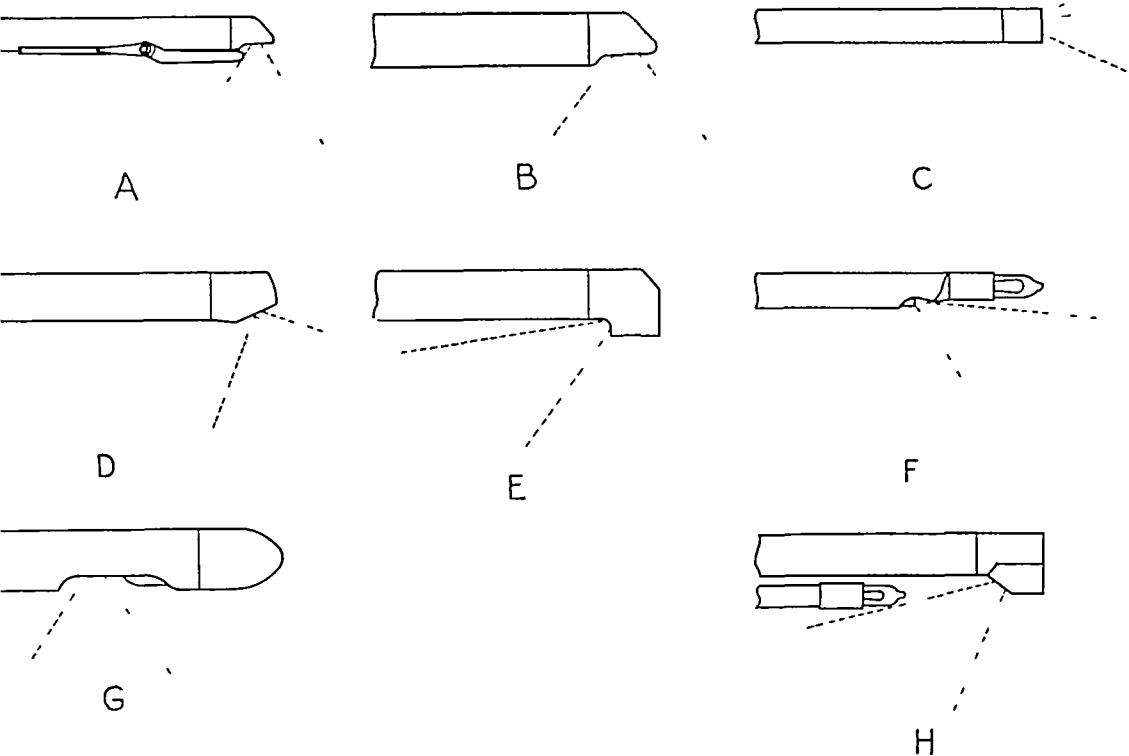


FIG 32 —Diagram of field of vision of various lenses A, right angle system for catheterizing telescope, B, right angle system for examining telescope, C, direct or forward vision, D, oblique system for close vision instruments, E, retrograde system, F, McCarthy foroblisque, G, right angle system for examination with telescope and light carrier combined, H, same as E with light carried

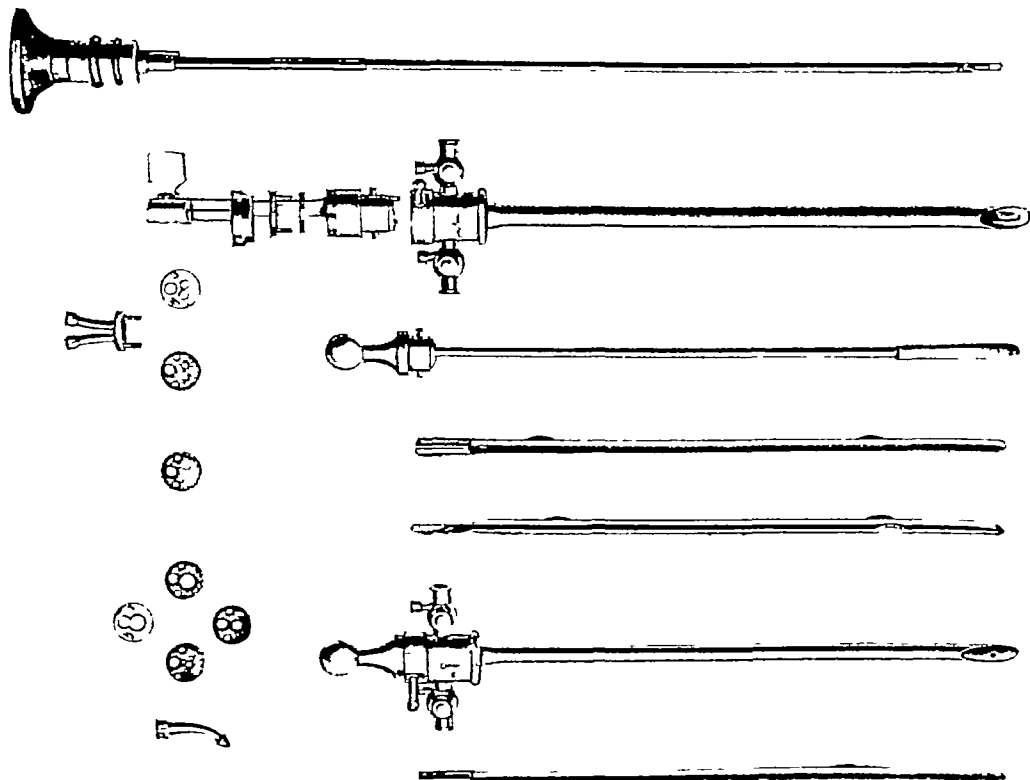


FIG 33 —McCarthy foroblisque pan-endoscope *

* Figs 32 to 40 furnished through the courtesy of American Cystoscope Makers, Inc
(36)



FIG. 1—Concave beath



FIG. 2—Conv x beath.

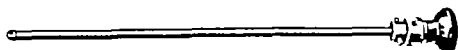


FIG. 3—L x an lining telescope



FIG. 4—Bismuth-Buenger double catheterizing telescope

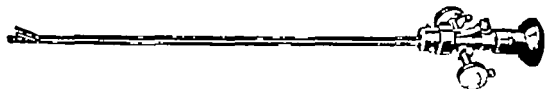


FIG. 5—Operating t lescope



FIG. 6—Obturator

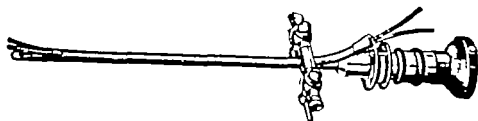


FIG. 7—McCarthy miniature cystoscope

Each of these sheaths employs the same observing and catheterizing telescope (Figs 36, 37, 38) The same obturator closes both fenestra (Fig 39) The convex type allows a closer approximation of the instrument to the bladder wall and is more satisfactory in examining the bladder neck and posterior urethra, particularly in cases where there is obstruction in the prostatic urethra These instruments are ordinarily constructed in several sizes The 24 Charrier is the most popular for general use The same instrument is furnished in smaller sizes, down to 21 and 17 Charrier scale

Several types of instruments for use in small children have been developed, notably those by Butterfield and Young Recently a children's instrument on the principle of the McCarthy Foroblique telescope has been placed on the market (Fig 40) While it has obvious mechanical defects which will unquestionably be remedied, it seems to be the most adaptable instrument for children at present available The importance of urological investigation in children is only beginning to be recognized and without question the diminutive armamentarium will soon be augmented with more satisfactory instruments

CYSTOSCOPIC ACCESSORIES

The source of electrical energy for lighting the cystoscope is drawn from two sources, line current and dry cells The standard lighting circuit has to be stepped down through a rheostat and is not shock-proof The most satisfactory lighting current is one drawn from dry cell batteries, two standard dry cell batteries being used in series These in turn should be connected with a rheostat in order to control the proper amount of current necessary to illuminate the filament While the dry-cell batteries can be used for only a relatively short period of time, they have the advantage of being absolutely safe to the patient They never produce a voltage of sufficient strength to give annoying shocks, which is sometimes the case when a line current is used The second advantage is that it is practically impossible to burn out a lamp with batteries, while great care must be taken when a line current is used, in properly regulating the rheostat The extra cost of the batteries may easily be saved in eliminating the changing of lamps at those intervals when the watchfulness of the operator or his assistant is diminished

Sterilization of Instruments —The sterilization of instruments is a much-discussed problem This should be done first by washing the cystoscope with soap and water Three types of sterilization are in ordinary use In the first, the cystoscope is immersed in carbolic acid and later washed in alcohol Either 5 per cent or 95 per cent phenol may be used As the sterilizing coefficient is the same in both cases, the 5 per cent solution is the most satisfactory because of its safety in handling Cystoscopes may be sterilized in formalin vapor or in formalin solution The disadvantage of this is the annoying odor from the formaldehyde and the difficulty in completely washing the instru-

ment following such sterilization. The use of cyanide of mercury solution is becoming more standard in instrument sterilization. This is a rapid and safe method and is applicable in all cases where urinary tuberculosis is not suspected. For the latter cases phenol is still the agent of choice. In this case the instruments are first soaked in phenol and later washed in alcohol and finally rinsed in sterile water.

The most important accessories in use with the cystoscope are the ureteral catheters. These are manufactured both in this country and abroad. They are available in a large number of standard sizes and shapes. Ureteral catheters may be sterilized with formalin solution, formalin vapor or cyanide of mercury solution. The latter is in most general use. Most ureteral catheters may be boiled and if they are immediately immersed in cold water following boiling they deteriorate very slowly. Catheters are made of wax and silk. In warm solution they are limp and unmanageable. If they are passed from the sterilizing solution through ice water they have greater rigidity and are more easily guided in their course.

A number of accessories for use in the various types of instruments have been built. They include fulgurating electrodes, special appliances for dilating ureters in order to dislodge calculi, scissors and rongeurs for cutting sections from bladder tumors and many others. Each new journal brings a description of some new appliance which may be employed for some special intravesical undertaking.

THE TECHNIQUE OF CYSTOSCOPY

The technique of cystoscopy involves two main factors, practice and dexterity. The beginner is earnestly advised to gain both through the use of a phantom bladder. Several very satisfactory models are upon the market. No instructor should allow a student, no matter how ambitious, to use cystoscopic instruments upon the human subject until this student has diligently practiced upon the 'phantom bladder.' Besides teaching the method of handling the instrument and catheters, the phantom bladder allows the student to become accustomed to orientation of the instrument. This does not mean that students must be denied the opportunity of seeing unusual lesions in the human subject under the direction of competent instructors. A very ingenious device whereby a second ocular may be attached to the observing lens is a very useful adjunct for any teaching clinic.

Preparation for Cystoscopy—In the past too little attention has been given to the comfort of the patient. Even in the hands of the most dextrous operator this simple procedure is often accompanied by considerable pain. This has unjustly given to cystoscopic procedure an unsavory reputation both with the profession and with the layman. It has often resulted in the putting off of very simple urological examinations. The profession and the patient have both suffered by the erroneous assumption that cystoscopic procedures are too painful to warrant the information that they might be able to bring to view.

In considering pre-cystoscopic medications, one must distinguish between the patient who has become adjusted to the necessary discomfort and the preliminary examination upon a new patient. The new patient suffers from apprehension, very often to a greater degree than from his urological lesion. To combat this, it is good practice to give the patient sufficient preoperative sedative so that he may reach the cystoscopic room composed and free from apprehension. Various medications will do this. We have found that the most satisfactory is pentobarbital sodium, given to the adult in a dosage of 3 grains about one hour previous to the examination. In children and in the aged, this dosage is reduced according to the standard rules of reduction of dosage for such patients. Even the youngest children tolerate 1 grain of pentobarbital sodium. It is only occasionally that an elderly patient cannot tolerate the full 3 grains. Idiosyncrasy to this drug is rare, almost wholly confined to the elderly patient and generally takes the form of hyperactivity. We have not found it necessary, as a rule, to give morphine as a preoperative drug but there is no contraindication to this if the patient is very apprehensive. The value of the barbituric acid product is twofold, (1) It causes a general relaxation of the patient with a reduction of his apprehension and (2) it acts as an antidote to cocaine and novocaine, local anesthetics which may be used in the urethra.

The use of cocaine as a local anesthetic in the urethra has been argued pro and con by many cystoscopists. It is undoubtedly the best local anesthetic which is available at the present time. While it results in an occasional reaction, recent pharmacological research has determined that the barbituric acid group are antidotes for these. [It is doubtful whether the barbituric acid derivatives can properly be referred to as antidotes in case of cocaine intoxication. Very considerable investigation by Professor Isenberger³¹ in 1928 showed that the barbituric acid derivatives would protect against convulsions. However, he pointed out that they are unable to overcome the depression caused by overwhelming doses. Lundy³² has also called attention to the effect of the barbiturates in controlling convulsions, but he does not believe that they can be regarded as antidotes for cocaine poisoning.—EDITOR.] A preoperative administration of any of the barbituric acid group will ordinarily preclude the possibility of such a reaction but even if this occurs, a hypodermic injection of phenobarbital sodium, now available in ampoule form, will always be sufficient to mitigate the symptoms. The widespread use of cocaine as a local anesthetic in many of the large urological clinics bears out contention of its usefulness and safety. This useful anesthetic has been employed for years by the oto-laryngologists, who have no fear in applying it in concentrated doses to surfaces which are even more sensitive to absorption than the lower urinary tract. It is, of course, obvious that in patients where a known sensitivity exists, a different form of anesthetic must be used.

Upon being brought to the cystoscopic room, the choice of local anesthetics depends very largely upon the procedure to be carried out

In the female patient a routine cystoscopic examination can ordinarily be carried on quite painlessly with very little anesthesia. It is our practice following the routine cleansing of the patient's genitalia first to apply a small cotton stick swab which has been soaked in 10 per cent cocaine. This is gently inserted into the external urinary meatus. After about a minute 2 cc. of 10 per cent cocaine are injected into the urethra and neck of the bladder with a Kevs-Utzman instillator. We feel that it is important to apply the cocaine locally through the instillator rather than force it into the urethra with a bulb syringe. Following this the stick applicator is again placed in the external urinary meatus and after two to five minutes the patient is ready for the examination.

In the male patient much the same procedure is carried out. Following the cleansing of the external parts a stick swab soaked in 10 per cent cocaine is placed in the external urinary meatus. The Kevs-Utzman instillator is then gently passed down the urethra into the bladder and 2 cc. of 10 per cent cocaine are now slowly injected. About one-half the amount is injected directly into the bladder to anesthetize the bladder neck while the remainder is allowed to trickle along the urethra as the instillator is withdrawn.

If a more analgesic or longer anesthesia is desired in either the male or the female it has been our practice to use a caudal anesthetic. We almost universally employ this procedure for initial examinations upon the male. This anesthesia is very quickly carried out by introducing a needle into the caudal canal and injecting about 30 cc. of 1 per cent novocaine. This procedure anesthetizes the floor of the bladder and the urethra with the exception of the external urinary meatus. The nerve supply to this area comes from a branch of the genitocrural nerve which is not affected by the caudal anesthesia. The sensitive external urinary meatus may be adequately numbed by introducing a cotton applicator soaked in 10 per cent cocaine. In cases where the procedure is extensive and protracted intravesical manipulation or operation is contemplated the use of low spinal anesthesia is advised. A general inhalation anesthesia is rarely necessary or advisable since the straining of a patient during such anesthesia makes cystoscopic procedures very difficult.

In infants and in children it is our practice to employ a preoperative dose of pentobarbital sodium and to rely upon a local application of 10 per cent cocaine to give sufficient anesthesia for any necessary cystoscopic procedure. In a rather wide experience with cystoscopy in children both in clinics and in private practice we have had surprisingly good results with this simple method of anesthesia. The use of general anesthesia in children is unnecessary. A few moments spent in gaining their confidence will often make of them the most cooperative of patients. The new field of usefulness which children's cystoscopy has brought to light gives a challenge to the urologist to study the application of these more benign types of anesthesia instead of the often terrifying and occasionally dangerous inhalation types.

The position of the patient is of great importance. A slightly modified lithotomy position will be found to answer in most cases. When the Kelly or Luys endoscope is used, the knee chest or exaggerated Trendelenburg position is necessary.

In the case of the female, the instrument is ordinarily readily introduced. It is, however, necessary to depress the instrument slightly as it moves upward past the meatus. In the male patient, the technique is a little more complicated. After the introduction of the instrument through the external urinary meatus, it is allowed to slip down the urethra as far as the bulb, where it meets the resistance of the bulbo-membranous junction. At this point, the instrument must be depressed until a sensation of penetration begins to make itself felt. The instrument will then pass through the posterior urethra and on into the bladder. Occasionally, in cases of prostatic enlargement, this maneuver can be simplified by introduction of the index finger of a free hand into the rectum, where pressure is exerted upon the membranous urethra. It is at this point that difficulty is often encountered in the introduction of the cystoscope. Once the instrument is in the bladder, the operator is ready for observation of the bladder area.

Use of the Cystoscope — It is not the purpose of this chapter to instruct either the student or practitioner in the use of cystoscopic instruments. This can only be done satisfactorily by observation and guidance under the direction of a competent instructor. Rather, we wish to stress a few simple points in technique, which will be found useful to all who find it necessary to use cystoscopic instruments.

Following the administration of the anesthetic, the next important step is the proper lubrication of the instrument to be used. Numerous lubricant jellies are on the market, put up in very convenient form. The oldest and one of the most useful lubricants is sterile olive oil. Its use has been advocated since the time of Ambrose Paré. Ureteral catheters when fitted into the catheterizing telescope, should always be lubricated with olive oil. This facilitates their passage through the instrument and through the ureter and minimizes the trauma and discomfort to the ureters during catheterization.

Observation Cystoscopy — In making an examination of the bladder wall, the cystoscopist must bear in mind the anatomical relations of the bladder, particularly with reference to the change in position and shape, during distention of the viscus with water. A partially filled bladder will oftentimes present a vastly different picture from that found at complete distention.

It is next important to have thoroughly in mind a routine for observation of the different portions of the bladder. The cone of light from the cystoscope will only illuminate a portion of the bladder wall and several motions of the instrument are necessary to bring into view the entire viscus. A well-thought-out plan of procedure by which different areas of the bladder are routinely observed, will enable the cystoscopist to make a complete and thorough examination in the shortest possible time. This necessitates having in mind the motions of the cystoscope

in carrying out this procedure. The simplest motion is that of rotation. By this means an annular band can be observed, which extends completely around the bladder (Fig. 31). As this will encompass only a small area of the bladder it will be necessary to move the cystoscope

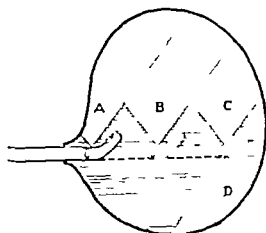


FIG. 41.—In position of (A) antero-superior (C) postero-superior and (B) vertex by motion of translation in a similar manner the floor of the bladder (D) is brought into view.

inward or outward to bring into view a succession of bands in a motion which has been called "Translation" (Fig. 41). The third movement is a pendulum or rocking motion such as is illustrated in Fig. 42. All of these motions must of course be combined to obtain a comprehensive view of the entire bladder wall.

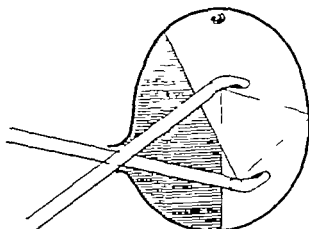


FIG. 42.—Rocking or pendulum motion to demonstrate the posterior wall.

A routine for inspection may be carried out as follows. After the insertion of the instrument the beak is turned upward until the air bubble comes into view (Fig. 43). The air bubble occupies the highest point in the bladder and is caused by air which enters the bladder with the instrument. This bubble will orient the cystoscopist and give him a point of departure. The instrument should be rotated clockwise

viewing the wall during the procedure. As the instrument comes to a position at about five o'clock, the left ureteral orifice should come into view. As the instrument reaches a position indicating six o'clock, the observer should be able to view the trigone. Rotation to about seven o'clock should reveal the right ureteral orifice. Following this, the

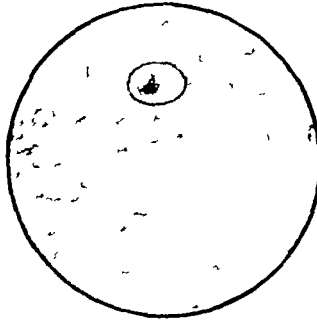


FIG. 43 —Air-bubbles seen with the beak turned upward when vertex is inspected

remainder of the bladder wall can be observed, while carrying the instrument back to the twelve o'clock position. The instrument may now be pushed inward or outward by the motion of translation and this same procedure carried out, in order to inspect the bladder wall completely. Once a comprehensive view of the bladder wall has been

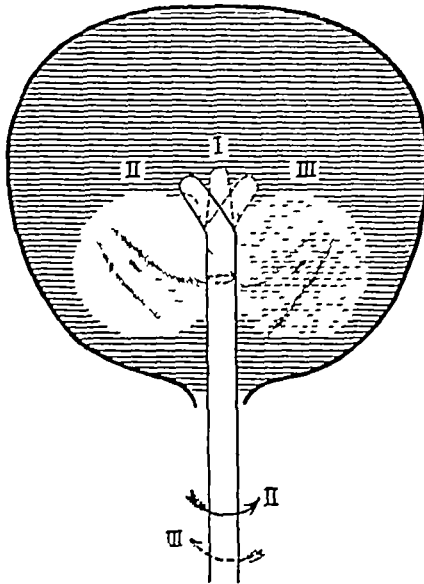


FIG. 44 —I, Cystoscope in midline II, turned to observe the right ureter, III, turned to see left ureter

obtained, noting its texture, size of vessels, the presence of diverticula, trabecular markings, ulcerated areas, tumors or foreign bodies such as calculi, the observer is ready to inspect what is probably the most important area of the bladder, namely, the trigonal area. The inspection of the trigone will give definitely the position of both ureteral

orifices (Fig. 44) together with the condition of the trigone itself. By partial withdrawal of the instrument the observer is now in a position to study the bladder neck (Fig. 45). It is at this area that hypertrophy of the prostate shows its encroachment. At the completion of the observation the instrument is withdrawn and as much of the urethra is studied as can be carried out with the type of cystoscope used.

Once the examination of the bladder has been made by the indirect lens the cystoscopist may now employ the different types of instruments available. The picture obtained will often amplify the knowledge of the bladder if some of the other forms of lenses are available for use. For instance a closer view of a tumor or stone may be obtained by a direct cystoscope while the use of a retrograde lens will greatly increase the information regarding the conformation of a prostatic hypertrophy.

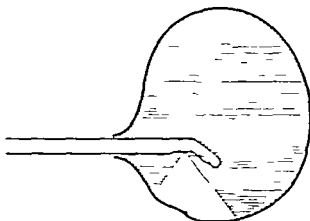


FIG. 45.—Cystoscope in position to observe inter-ureteric ridge.

Ureteral catheterization, the most common procedure carried out through a cystoscope, is generally done with the Brown Berger type of instrument. The catheterizing telescope is threaded with ureteral catheters. The cystoscope having been introduced and the ureteral orifices located, the catheters are now brought up close to the ureteral orifices and by a little pressure may be drifted up the ureter. In this case also it is well to carry out a routine in which either one or the other of the ureteral orifices is first catheterized. While such a routine may seem rather stereotyped, its constant use will allow the operator to carry out his procedure in a much shorter time than with a more haphazard method of procedure. In developing dexterity at ureteral catheterization we again recommend the beginner to spend hours of practice with the phantom bladder.

If an open-air endoscope is being used distention of the bladder is induced by posture. The speculum or urethroscope is introduced, the orifices are located as illustrated in Fig. 23 and the catheter introduced under direct observation.

Operative Cystoscopy—This includes the special diagnostic and therapeutic manipulations that can be carried out through a catheteriz-

viewing the wall during the procedure. As the instrument comes to a position at about five o'clock, the left ureteral orifice should come into view. As the instrument reaches a position indicating six o'clock, the observer should be able to view the trigone. Rotation to about seven o'clock should reveal the right ureteral orifice. Following this, the

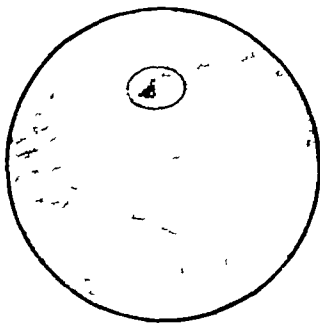


FIG 43 —Air-bubbles seen with the beak turned upward when vertex is inspected

remainder of the bladder wall can be observed, while carrying the instrument back to the twelve o'clock position. The instrument may now be pushed inward or outward by the motion of translation and this same procedure carried out, in order to inspect the bladder wall completely. Once a comprehensive view of the bladder wall has been

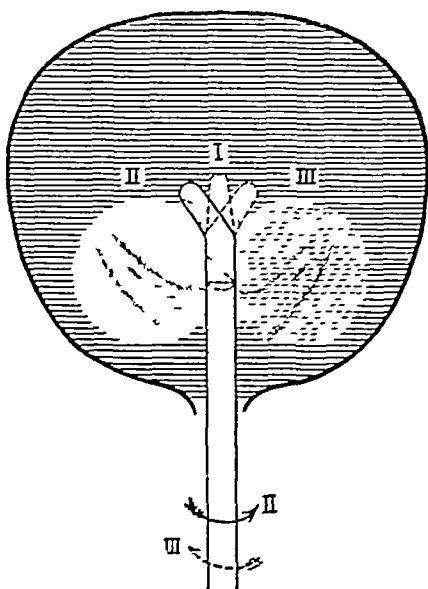


FIG 44 —I, Cystoscope in midline II, turned to observe the right ureter, III, turned to see left ureter

obtained, noting its texture, size of vessels, the presence of diverticula, trabecular markings, ulcerated areas, tumors or foreign bodies such as calculi, the observer is ready to inspect what is probably the most important area of the bladder, namely, the trigonal area. The inspection of the trigone will give definitely the position of both ureteral

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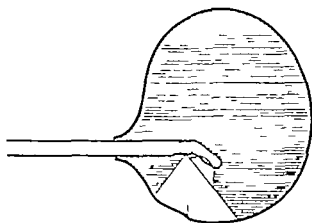


FIG. 45 — Cystoscope in position to observe inter-ureteric ridge

Ureteral catheterization the most common procedure carried out through a cystoscope is generally done with the Brown Berger type of instrument. The catheterizing telescope is threaded with ureteral catheters. The cystoscope having been introduced and the ureteral orifices located the catheters are now brought up close to the ureteral orifices and by a little pressure, may be drifted up the ureter. In this case also it is well to carry out a routine in which either one or the other of the ureteral orifices is first catheterized. While such a routine may seem rather stereotyped its constant use will allow the operator to carry out his procedure in a much shorter time than with a more haphazard method of procedure. In developing dexterity at ureteral catheterization we again recommend the beginner to spend hours of practice with the phantom bladder.

If an open-air endoscope is being used distention of the bladder is induced by posture. The speculum or urethroscope is introduced the orifices are located as illustrated in Fig. 23 and the catheter introduced under direct observation.

Operative Cystoscopy — This includes the special diagnostic and therapeutic manipulations that can be carried out through a catheteriz-

viewing the wall during the procedure. As the instrument comes to a position at about five o'clock, the left ureteral orifice should come into view. As the instrument reaches a position indicating six o'clock, the observer should be able to view the trigone. Rotation to about seven o'clock should reveal the right ureteral orifice. Following this, the

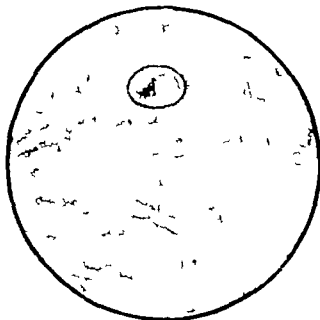


FIG 43 —Air-bubbles seen with the beak turned upward when vertex is inspected

remainder of the bladder wall can be observed, while carrying the instrument back to the twelve o'clock position. The instrument may now be pushed inward or outward by the motion of translation and this same procedure carried out, in order to inspect the bladder wall completely. Once a comprehensive view of the bladder wall has been

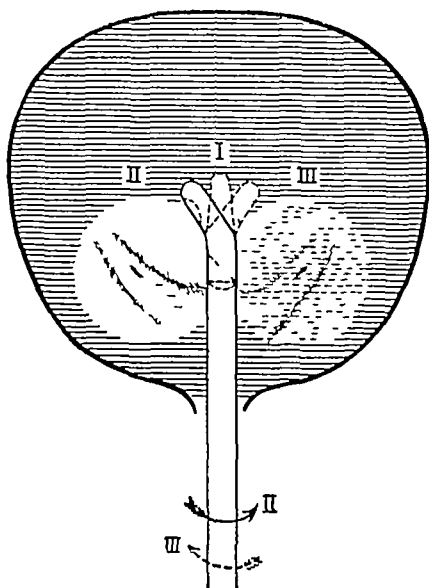


FIG 44 —I, Cystoscope in midline, II, turned to observe the right ureter, III, turned to see left ureter

obtained, noting its texture, size of vessels, the presence of diverticula, trabecular markings, ulcerated areas, tumors or foreign bodies such as calculi, the observer is ready to inspect what is probably the most important area of the bladder, namely, the trigonal area. The inspection of the trigone will give definitely the position of both ureteral

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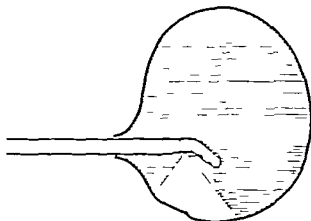


Fig. 44.—Cystoscope in situ (indirect lens). Internal view.

Ureteral catheterization, the most common procedure carried out through a cystoscope, is generally done with the Brown Berger type of instrument. The catheterizing telescope is threaded with ureteral catheters. The cystoscope having been introduced and the ureteral orifices located, the catheters are now brought up close to the ureteral orifices and by a little pressure may be drifted up the ureter. In this case also it is well to carry out a routine, in which either one or the other of the ureteral orifices is first catheterized. While such a routine may seem rather stereotyped, its constant use will allow the operator to carry out his procedure in a much shorter time than with a more haphazard method of procedure. In developing dexterity at ureteral catheterization we again recommend the beginner to spend hours of practice with the phantom bladder.

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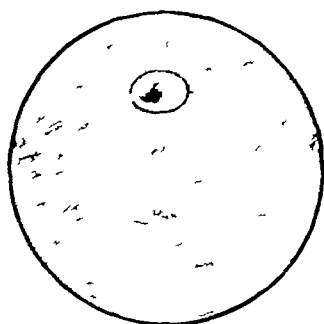


FIG. 43 — Air-bubbles seen with the beak turned upward when vertex is inspected

remainder of the bladder wall can be observed, while carrying the instrument back to the twelve o'clock position. The instrument may now be pushed inward or outward by the motion of translation and this same procedure carried out, in order to inspect the bladder wall completely. Once a comprehensive view of the bladder wall has been

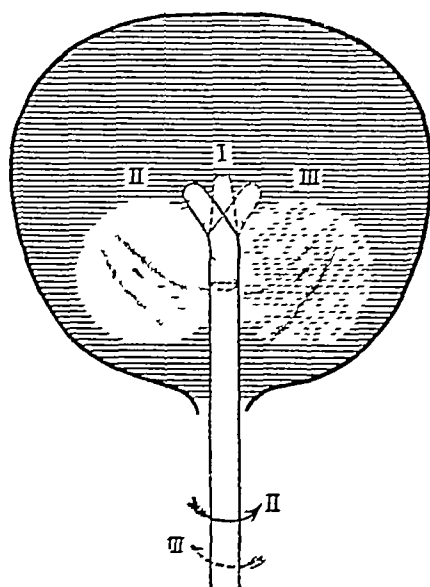


FIG. 44 — *I*, Cystoscope in midline. *II*, turned to observe the right ureter. *III*, turned to see left ureter.

obtained, noting its texture, size of vessels, the presence of diverticula, trabecular markings, ulcerated areas, tumors or foreign bodies such as calculi, the observer is ready to inspect what is probably the most important area of the bladder, namely, the trigonal area. The inspection of the trigone will give definitely the position of both ureteral

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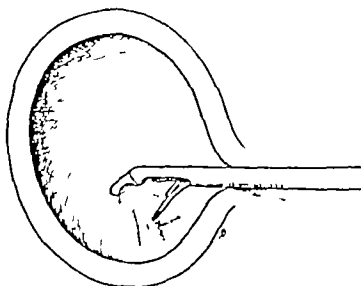


FIG. 49.—Normal ureteral catheterization. Third move. Catheter has received its full insertion.



FIG. 50.—Cystoscopic view. The catheter tip lies just below the ureteral opening; view seen in Fig. 49.

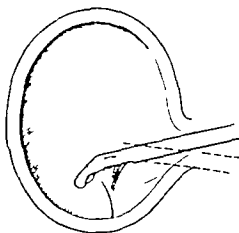


FIG. 51.—Normal ureteral catheterization. Fourth move. The tip of the catheter is made to enter the ureter.



FIG. 52.—Cystoscopic view. Catheter has entered; view seen in Fig. 51.

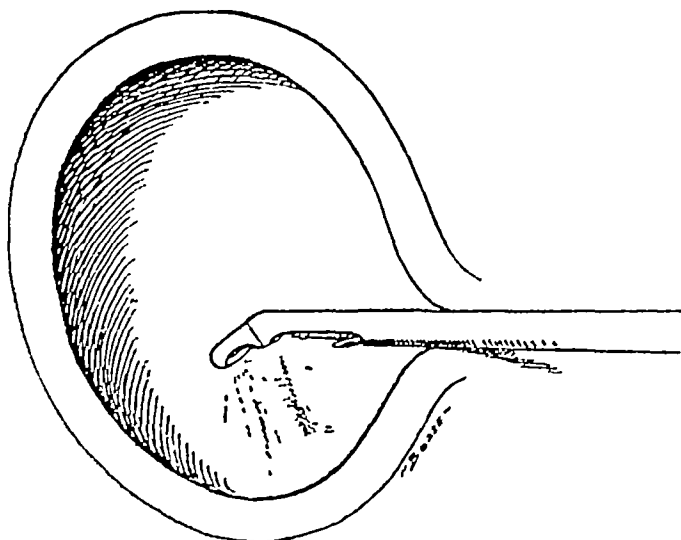


FIG 46 —Cystoscope in position to begin introduction of catheter

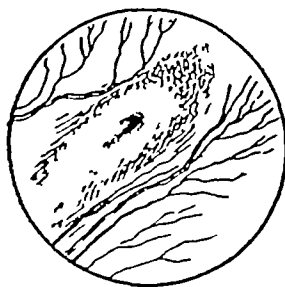


FIG 47 —Cystoscopic view in first move the ureter slightly above the center of the field

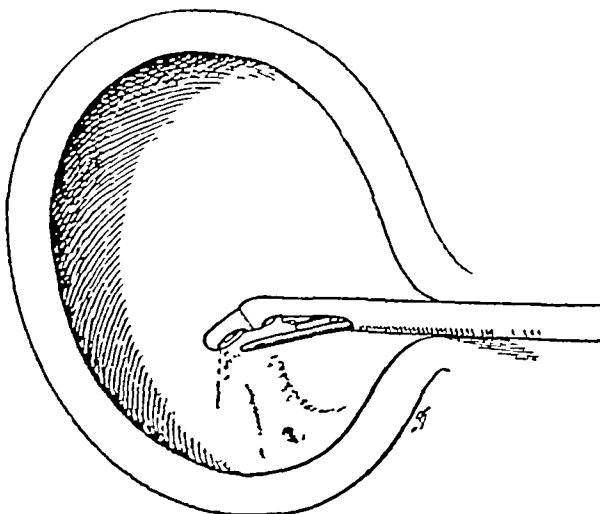


FIG 48 —Normal ureteral catheterization Second move The tip of the catheter lies beyond the field

ing cystoscope or through a special type of operating cystoscope. Such procedures are described in the chapters dealing with these conditions. Specially designed instruments are available for these purposes.

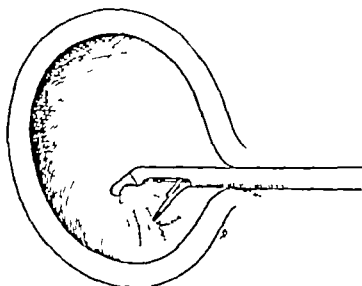


FIG. 49.—Normal ureteral catheterization. Third move. Catheter has received its full inclination.



FIG. 50.—Cystoscopic view. The catheter tip lies just below the ureteral opening, view seen in Fig. 49.

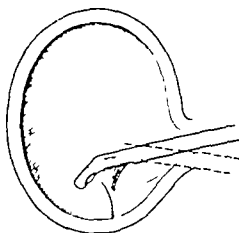


FIG. 51.—Normal ureteral catheterization. Fourth move. The tip of the catheter is made to enter the ureter.



FIG. 52.—Cystoscopic view. Catheter has entered. View seen in Fig. 51.

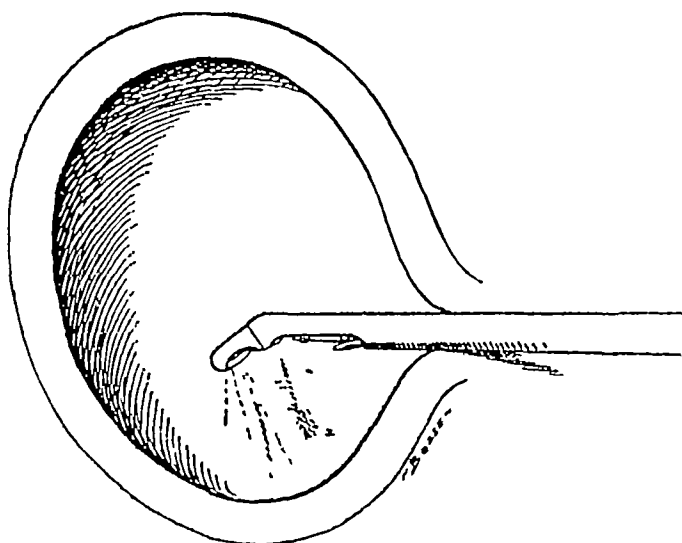


FIG 46 —Cystoscope in position to begin introduction of catheter



FIG 47 —Cystoscopic view in first move the ureter slightly above the center of the field

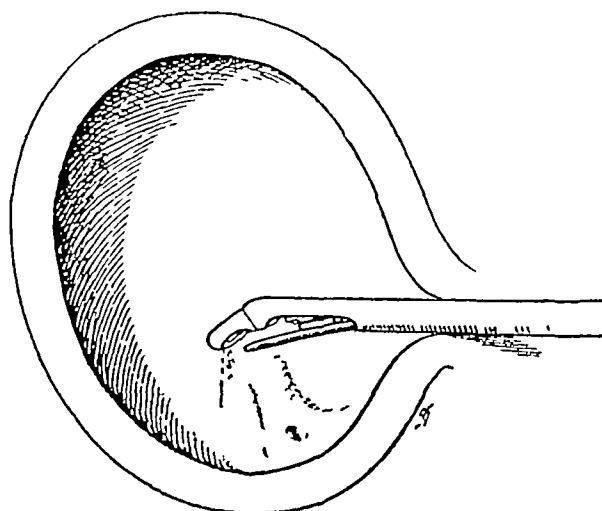


FIG 48 —Normal ureteral catheterization Second move The tip of the catheter lies beyond the field

from the mountain region the acclivity can be followed by its tapering crest to the membranous urethra. This area is very short and can generally be identified by its striking pallor due to avascularity. As the instrument is further withdrawn the bulbous portion of the pendulous urethra comes into view. This area is of large diameter. The floor presents a corrugated appearance with an occasional transverse fold. As the instrument is withdrawn into the pendulous portion of the urethra the openings of the glands of Littre can be distinguished.



FIG. 31.—Floor of the sphincter and supramontane urethra.



FIG. 32.—Normal colliculus showing three vertical slits, the utricle in the center and the ejaculatory ducts on either side.

Operative Urethroscopy—This includes all therapeutic procedures that are feasible by means of a urethroscope or cysto-urethroscope. A few instruments will suffice to do all the necessary therapeutic work in the anterior urethra. Cotton applicators, probes, high frequency applicators, alligator forceps, all should be available. For inspection of the urethra the straight tube such as described by Valentine, Lusk, Young and others is admirable. For the posterior portion of the urethra the cysto-urethroscope is more useful. Instruments have been devised to carry loops for electro-surgical resection of urethral and bladder-neck obstructions.

The insertion of these straight tubes is sometimes difficult. They must be delicately handled to avoid making a false passage. If the instrument does not slip readily into the posterior urethra the index finger of the free hand passed into the rectum to close off the membranous portion of the urethra is often helpful. Numerous procedures may be carried out through the urethroscope. These are described in the chapter on the Treatment of Disease of the Urethra.

A century has passed since man first began to throw feeble beams of artificial light down the urinary tract. During this period the workers in this field have taken advantage of every parallel advance in scientific achievement which would further their efforts. Their instruments have grown from a simple tube illuminated by flickering candle light to a miniature telescope fitted with lenses of the finest construction and illuminated with a cold light of splendid incandescence which we owe to the genius of Edison.

The science of urology has grown up about this instrument. Developing with it urology has become the most exact of clinical sciences. A completed clinical urological study seldom leaves any fundamental

URETHROSCOPES AND URETHROSCOPY

Urethroscopy deals with the inspection of the male or female urethra first sees the prostatic urethra, next, the short membranous urethra, in its entirety. In the male, from the bladder outward, the observer then the long pendulous or anterior urethra, as illustrated in Fig 53. In the female, the entire canal may be considered as being divided into the sphincteric portion and the urethral portion.

The simplest and most useful instrument for viewing the anterior urethra is a tube into which light can be thrown, either from without, by means of a small electric lamp, or from within, by means of a light carrier introduced into the tube (Fig 21). A small magnifying lens is valuable to enlarge the picture. Cysto-urethroscopes may also be used for this purpose. In the female, the urethra is short and observation is first made of the bladder neck, following which the instrument is gently withdrawn, viewing the entire urethra during the procedure.

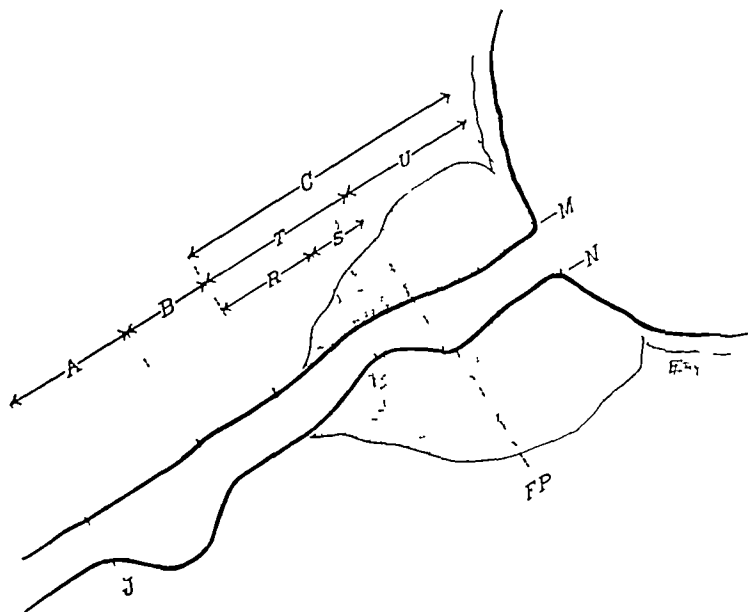


FIG 53 — Diagrammatic subdivision of the posterior urethra, the membranous urethra and bulb

In the male, following the introduction of the urethroscope and the removal of the obturator, the instrument is gently withdrawn until the bladder neck is brought into view. On gradual withdrawal, the area of the verumontanum is brought into view (Figs 54 and 55). The verumontanum has a summit. This varies greatly in size. The posterior portion is often called the declive and the anterior portion is called the acclive. In most cases the ejaculatory duct can be made out as two symmetrically situated orifices somewhat below and to either side of the utricle. Lateral to the verumontanum may sometimes be noted the prostatic ducts, which form slit-like openings along the floor of the urethra. The mucous membrane here is pale reddish yellow and the vascular markings are in the form of irregular longitudinal streaks and tortuous delicate vessels. As the instrument is withdrawn

from the montane region the acclive can be followed by its tapering crest to the membranous urethra. This area is very short and can generally be identified by its striking pallor due to avascularity. As the instrument is further withdrawn the bulbous portion of the pendulous urethra comes into view. This area is of large diameter. The floor presents a corrugated appearance with an occasional transverse fold. As the instrument is withdrawn into the pendulous portion of the urethra the openings of the glands of Littre can be distinguished.



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caused by hematocele, hydrocele or spermatocele. The relation of the fluid to the body of the testis is suggestive of the nature of the enlargement, although positive evidence may be obtained on aspiration under the strictest aseptic technique. The fluid of spermatocele is distinguished by the opalescent, foamy appearance and the presence of spermatozoa. Solid tumors may be neoplasms or may be secondary to an inflammatory process. The possibility of hernial content being in the scrotum always should be borne in mind. The discovery of varicocele of recent origin often indicates that a tumor in the upper lateral portion of the abdomen is a renal neoplasm.

A general examination is not complete without a digital examination of the rectum, and if it were made as much of a routine as is determination of the pulse-rate, many errors in diagnosis would be eliminated. The rectal shelf, prostate gland and seminal vesicles should be carefully palpated. Relaxation of the rectal sphincter suggests a lesion of the spinal cord, although it is by no means a constant observation in the presence of such a lesion. Asymmetrical nodular enlargement of the prostate and seminal vesicles may suggest tuberculosis. Prostatic crepitation, felt on rectal palpation, sometimes will reveal the presence of calculi, and when the stones are large they can be recognized easily. Although the hard, irregular deformity of the prostate which results from carcinoma is characteristic, it may be difficult to distinguish from fibrosis resulting from prostatic infection. Induration of the base of the bladder, often easily recognized on rectal or vaginal examination, may indicate limitations of treatment as well as probabilities in prognosis.

Many data of importance can be obtained by routine vaginal examination. A thickened, cord-like ureter, felt in the anterior wall, may indicate the diseased ureter of renal tuberculosis. A stone in the intramural part of the ureter sometimes can be felt. Evidence of vaginal and pelvic disease definitely related to lesions in the urinary tract is frequently observed. Inspection of the vulvo-vaginal region and of the external part of the urethra may reveal the cause of frequent micturition and dysuria.

It cannot be overemphasized that physical examination confined to the genito-urinary tract alone will not disclose the existence, in other regions, of disease which might be fully as important as the lesion in the genito-urinary tract. Furthermore, clinical signs caused by lesions in organs outside of the urinary tract may closely simulate those observed with genito-urinary disease. The urologist who does not insist on a thorough general examination of the patient has lost sight of the fact that disease usually has multiple ramifications, of which that existing in the genito-urinary tract may be only a small part.

CYSTOSCOPY

It is now almost sixty years since Nitze brought out the first successful cystoscope and, although greatly modified, it has been of incalculable value throughout these years in the diagnosis of lesions

involving the urinary tract. The widespread use of the cystoscope is an interesting development in medicine of today. There is scarcely a surgeon, particularly in smaller communities, who does not possess and use a cystoscope. As a result many lesions in the urinary tract which would otherwise be overlooked are recognized. Although the recent introduction of excretory urography has somewhat impaired the diagnostic usefulness of cystoscopy, still it remains essential to diagnosis of most lesions in the urinary tract.

The original cystoscope has undergone innumerable modifications in the course of years and today a wide array of instruments is available. The various changes consist largely of the development of better and of multipurpose lenses, variations in the sheath to suit the purpose intended, and the addition of efficient irrigation. To the credit of American instrument makers it should be said that their products in most respects excel those of European origin. That many of the more complicated lens cystoscopes are not essential to competent cystoscopy is shown by the extensive use of the direct vision cystoscope without lens. Although instruments which allow of direct vision usually suffice for most transurethral procedures, yet the fibroblaque and rectangular lenses are often of additional advantage. Adequate visualization of the tissues at the vesical neck of the male frequently requires additional use of the retrograde lens. Catheterization of the ureters is equally feasible with both direct and indirect cystoscopes. The direct cystoscope has the advantage of giving information in regard to the nature of an obstruction by means of direct contact of the catheter with the obstruction. After all, it is not the type of instrument employed, but the interpretation of findings which is essential.

In the technique of cystoscopy the choice of anesthetic remains controversial. Local anesthesia by intra urethral injection of 60 cc. of a freshly prepared 2 per cent solution of cocaine, or by procaine or diothane is frequently employed. The use of cocaine is contraindicated immediately following trauma to the urethra by the passage of a catheter or by other instrumentation. The objections to the use of diothane are the length of time necessary to produce anesthesia and the milky appearance of the urine evacuated. Although spinal or caudal anesthesia is often used if patients are markedly intolerant of instrumentation in some cases gas anesthesia is preferable. The recent development of intravenous injection of one or another of the barbiturates bids fair to supersede all methods of general anesthesia.

Other methods of diagnosis in which cystoscopy is employed will be taken up later in this chapter.

URINALYSIS

The necessity of routine urinalysis preliminary to clinical examination is generally recognized. The tendency in recent years has been to accept the usual voluminous report of urinalysis with its micro-

scopic and chemical examination, and to pay scant attention to the gross appearance of the urine. Although the days of the uroscopist are long past, nevertheless neglect of the many valuable data available from gross inspection of the urine is regrettable. Much information of value can be gained from a routine two-glass test.

It should first be noticed whether the urine is clear, hazy, cloudy or bloody, and whether it contains shreds or mucus. It should be emphasized, however, that clear urine does not rule out the presence of microscopic pyuria or bacteriuria. It is generally recognized that the first glass will contain the secretion from the urethra and that the second glass will give an index of the condition of the urine in the bladder. Alteration in color of the urine may be of clinical importance. The color varies widely with the degree of concentration. It is often affected by various modern, expensive drugs which are of doubtful antiseptic value. A milky tinge may be caused by deposit of urates (disappearing on heating), or of phosphates (disappearing with addition of acetic acid). The discoloration caused by vaginal discharge should not be forgotten. Gross inspection of the urinary sediment may be of value in furnishing a clue to the cause of recurring nephrolithiasis. After the urine has been allowed to stand overnight in a conical urine glass, a brick-red deposit at the bottom would indicate crystals of uric acid.

Microscopic study of the urinary sediment also may be of considerable value. A count should be made of the erythrocytes and leukocytes per high-power microscopic field. It should be mentioned that microscopic examination of the sediment of urine kept in a warm room for several hours may be misleading, since the large amount of mucus present may alter or conceal the presence of pus or erythrocytes. For microscopic purposes, therefore, examination of fresh urine is preferable. It is difficult to understand why many clinicians continue to pay any attention to microscopic examination of a specimen of urine voided by the female patient, since the urine is so often contaminated by vaginal or urethral secretion. The finding of supposedly pathological elements in the urine of women is quite misleading unless the specimen has been obtained by careful catheterization.

A Gram stain of a dry smear of the sediment, and examination for the presence of bacteria and their type, if found, is of the greatest importance, both from a diagnostic and from a therapeutic standpoint. It makes possible determination of whether or not an infecting organism is present and also allows a rough grouping as to the type of organism. Identification of the organism present is also of considerable clinical importance. A Gram stain of a smear of the urinary sediment should be made as a routine, although when negative, it usually will exclude the presence of bacterial infection, nevertheless, for certainty, culture of the urine should be made in most cases. Only by means of a culture can the exact type of organism be determined.

Odor—Ammoniacal changes in the urine can be detected easily by the odor given off and may lead to recognition of unsuspected

urinary retention. Urine infected with urea-splitting bacteria may have a decidedly ammoniacal odor. The foul odor which often accompanies necrosis of a vesical malignant growth may be recognized by the experienced examiner.

Determination of Hydrogen Ion Concentration.—The clinical importance of the reaction of the urine has been appreciated to a greater extent in recent years than before. In fact, determination of the pH of the urine should be included in routine urinalysis. If the pH persists on the alkaline side, it may be indicative of infection with urea-splitting bacteria which are frequently found in the presence of lithiasis in the urinary tract and with retention of urine. Determination of the pH is essential to intelligent control of bacillary infection. It is of value as a guide to employment of the ketogenic diet and consequent acidification of the urine. It has been found that in order to have a bacteriostatic or bactericidal action the ketonurine should have a pH of 5.5 or less.

Crystals.—Microscopic examination of the urine for the presence of crystals occasionally is of value. Showers of crystals found in the urine soon after renal colic often will indicate the cause of the pain when the roentgenogram is negative. Turbidity of the urine often is caused by a heavy deposit of calcium phosphate in amorphous or crystalline form. Showers of crystals of calcium phosphate may be observed if patients form repeated stones and pass them at frequent intervals. The presence of large quantities of uric acid crystals in the urinary sediment may indicate not only the diagnosis but may also determine the treatment. The finding of cystine crystals may also be of value in the diagnosis of cystine stones.

BIOPSY FOR SUSPECTED MALIGNANT CONDITIONS

Examination of tissue from the urinary tract either voided or removed through the cystoscope is frequently of the greatest importance in the recognition of malignancy. It is often impossible to distinguish by gross inspection between malignant conditions and granulomas. In such cases biopsy is the only way in which the exact diagnosis can be made. Error in diagnosis sometimes occurs because although a malignant growth is present in the tract, the specimen that is secured is from adjacent benign tissues. A neoplasm in the bladder is frequently surrounded by inflammatory tissue which closely resembles it and the tissue removed may come from this portion. Therefore if the tissue removed is reported as inflammatory, a second and even a third specimen is sometimes necessary in order to exclude the possibility of malignancy. Diagnosis of specimens removed for biopsy has been criticized on the ground that a superficial portion of the tumor may be only slightly malignant and the central portions highly malignant. Frater has shown, however, that such error occurs but rarely and for practical purposes it is negligible. Not alone will biopsy identify the nature of a growth but if the growth is malignant

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often stubbornly resists elimination. Although *Proteus ammonium* will be affected by the ketogenic diet when the pH of the urine is within normal limits with markedly alkaline urine it may be impossible to affect it by any form of diet or medication. It should be remembered that the absence of pus cells does not exclude marked bacterial infection. In fact urinary frequency and dysuria in the absence of urinary pus and when cystoscopic examination apparently is negative may be easily regarded as functional unless a search both with microscope and by culture is made for bacteria in the urine.

Bacteriological study of the blood when acute fulminating renal infection is present often is of great clinical value. Cultures made of the blood, particularly after acute rise in temperature or after chills, will determine the existence of general systemic infection and also will act as a guide to intravenous therapy. It has been observed that cocci frequently are affected by intravenous injections of gentian violet or neosarsphenamine whereas bacillary infection more often will respond to intravenous injections of methanamine or mercurochrome.

URETHRAL SECRETIONS

Approximate localization of infection of the urethra is usually possible with the aid of the 2 or 3-glass tests. A careful search for the gonococcus by smear and by culture, always should be made when there is a secretion from the urethra. Recently discovered methods of culture have been of great aid in the search for gonococci. Taking advantage of the fact that the gonococcus is susceptible to heat, it has recently been demonstrated that hyperpyrexia as now induced with a specially constructed apparatus will eliminate gonococcal infection in more than 90 per cent of cases. Bacterial examination of the prostatic secretion is not as simple as is examination for bacteria of the urinary tract since the multiplicity of bacteria frequently observed may be confusing. However when there is a predominating organism particularly a streptococcus its recognition may be of value as a guide to the use of vaccines or of intraprostatic or intravenous therapy. A count of the number of pus cells to the field as well as identification of the bacteria present is of value in noting the degree of progress under therapy.

The comparatively recent discovery of *Trichomonas vaginalis* in the vaginal discharge has shown that it is often the cause not only of vaginitis but also of secondary urethritis and in the occasional case of cystitis. In the presence of infection of the urethra careful search for this organism also should be made.

ESTIMATION OF RENAL FUNCTION

Tests of renal function applied in the presence of surgical conditions involving the urinary tract differ somewhat not only in type but also in interpretation from those made when there are so-called medical lesions of the kidney.

it will determine the degree of malignancy. Biodeis' classification of malignancy has been accepted generally, and when applied to the tissue removed for study, gives an accurate estimate not only as to prognosis, but also as to the best method of treatment.

BACTERIOLOGY.

Sufficient attention has not been given to routine examination of the urine for bacteria. Only in recent years have members of the medical profession appreciated the clinical importance of demonstrating not only the presence of bacteria, but their generic nature. Aside from examination of the urethral discharge for *Neisseria gonorrhœæ* (gonococci), and examination of the urine for bacilli of tuberculosis, the bacteriology of the urinary tract has been generally regarded as being of more or less academic interest only. It was taken for granted that with the exception of the organisms above named, the bacteria found in the urine would be either colon bacilli or cocci, and from a therapeutic standpoint it did not matter which they were. Intensive study of the bacteria involved in infections of the urinary tract has shown, however, that the type and intensity of the lesion varies considerably with the different bacteria and that the response to various agencies employed in urinary antisepsis is also quite different. It has been found that the ketogenic diet and acidification of the urine are efficacious only against bacillary infections, whereas coccal infections respond best to intravenous injections of neoarsphenamine. To distinguish between cocci and bacilli is important in cases of acute infection of the kidney, since cocci usually indicate that the infection predominates in the renal cortex, and bacilli usually are found when the predominant infection is in the central and collecting portions of the kidney.

Careful identification of the type of bacillus present is also of definite clinical importance. Of the bacilli, the most common invader is *Escherichia coli*, and less frequently, *Ærobacter ærogenes*. In addition, members of the genera *Proteus*, *Pseudomonas*, *Alcaligenes*, *Salmonella* and *Shigella* are discovered, in the foregoing order of frequency. Of the cocci a green-producing streptococcus and *Streptococcus faecalis* are most frequently observed, although members of the genera *Micrococcus* and *Staphylococcus* and hemolytic streptococci are also found. The presence of micrococci and staphylococci frequently is the result of instrumental contamination, although each may be, in itself, the primary infecting organism. It is advisable to determine which of the two more common bacilli of the colon group are present, namely, *Escherichia coli* or *Ærobacter ærogenes*. Although in children all types of bacteria are affected almost to an equal degree, by ketonuria, in the adult, *Escherichia coli* are somewhat more susceptible to ketosis. Bacteria such as those of the genera *Proteus* or *Alcaligenes* should be identified because of their tendency to split-urea. Recognition of *Proteus ammoniæ* is particularly important in the presence of recurring formation of renal calculi and the organism

opinion of many urologists that estimation of creatinine gives a better index of prognosis than any other test. If the blood urea is markedly elevated (80 to 100 mg) and the creatinine remains comparatively low (2 or 3 mg) the prognosis would be considerably better than if the readings for creatinine were abnormally high. It has been stated that with a blood creatinine of 10 mg or more a fatal outlook usually can be assumed. However in exceptional cases extremely high readings for blood creatinine eventually can be reduced to normal with proper treatment.

Phenolsulphonephthalein.—Of the various excretory tests of renal function the rate of excretion of phenolsulphonephthalein when injected intravenously probably is the most satisfactory. The test made with the standard ampule of phenolsulphonephthalein consisting of 1 cc. of a 0.0 per cent solution is performed as follows. The content of the ampule is injected intravenously and the urine is collected for an hour and fifteen minutes. This interval of time has been chosen because it has been estimated that under normal conditions 40 per cent of the drug is eliminated in the first fifteen minutes, approximately 17 per cent during the second fifteen minutes, 5 per cent during the third fifteen minutes and 4 per cent during the fourth fifteen minutes. The average return in the second hour is about 1 per cent. A knowledge of this rate of elimination has been the means of arriving at a fractional functional determination which is particularly adaptable to patients who are being prepared for prostatectomy. A delay in the excretion of the dye in the first two fifteen minute specimens is indicative of renal disease and it may be advisable to delay surgical procedures until improved function has been restored. A slow rate of excretion of phenolsulphonephthalein should be checked by repeated studies, and errors incident to faulty drainage or to residual urine in the bladder must be corrected. The causes of such errors will be mentioned in the next paragraph. If the total excretion two hours after injection is persistently less than 60 per cent it is regarded as suggestive of renal insufficiency in the presence of medical conditions of the kidney. An excretion as low as 40 per cent is frequently observed when there are surgical lesions in the urinary tract however and has no great clinical significance. With lower readings, it is usually necessary to distinguish between a condition causing retarded excretion and permanent renal damage.

A reduced excretion of phenolsulphonephthalein frequently may be the result of error in technique such as incomplete or faulty intravenous injection, delay in excretion because of various anatomical factors, failure to empty the bladder completely, or faulty collection of urine.

The prognosis in the presence of elevation of blood urea or of low excretion of phenolsulphonephthalein may be difficult since patients who can excrete only a trace of phenolsulphonephthalein in the urine and whose concentrations of blood urea are very high frequently live for several years. Although the output of phenolsulphonephthalein and the concentration of blood urea usually run parallel exceptions

Concentration Tests and Blood Chemical Determinations.—Among the tests employed when non-surgical lesions of the kidney are present may be mentioned study of the ability of the kidneys to concentrate urine under standard conditions, estimation of plasma chlorides or of serum sulphates, and the carbon dioxide combining-power of the plasma. Reduction of renal function caused by retention of urine, infection or reflex disturbance, must be considered on an entirely different basis from that occurring with the various forms of nephritis or nephrosis. In the presence of surgical conditions, the tests of renal function most frequently used are estimation of the degree of retention of nitrogen in the blood and the measured excretion of phenol-sulphonephthalein. It is difficult to make any estimate of the comparative value of the tests of excretion and of retention. There may be special indications for either one, and in case of discrepancy, clinical factors may indicate that greater reliance should be placed on one than on the other. As a rule, the tests of retention give a more accurate index as to renal function in cases of urinary retention than the tests of excretion, although the data to be derived from both are often desirable.

Estimation of the blood urea probably offers the best general index of renal function. Although the concentration of urea in the normal adult is not more than 35 mg. per 100 cc. of blood, it is not at all uncommon to find a concentration of urea of 40 mg. in adults who are more than forty years of age, without other clinical data suggestive of renal insufficiency. In fact, unless the concentration of blood urea is considerably more than 40 mg., it usually is not regarded as a barrier to surgical procedure. When the reading is more than this, however, a further check of renal function, including tests of excretion, is desirable.

As a result of renal back-pressure in the presence of obstruction at the outlet of the bladder or in the ureter, a blood urea of high concentration frequently is observed, occasionally reaching as high as 200 or 300 mg. Under these extreme circumstances, with adequate urinary drainage, dietary precautions and other methods of therapy, the renal function frequently can be brought back to normal limits. It is surprising how well surgical operations are borne by patients whose blood urea is of high concentration if the value can be reduced to a level of between 50 and 100 mg., and if the general condition of the patient is otherwise satisfactory. When observed several years later some of these patients apparently are in good health although their blood urea may remain so elevated that under ordinary circumstances it would be regarded as abnormal. Marked increase in concentration of blood urea frequently is observed in the presence of polycystic kidney and other renal lesions which are not accompanied by any subjective evidence of renal insufficiency. Unless there is evidence of urinary stasis, however, the advisability of operation is questionable.

Among the other tests of retention used in determining renal function, estimation of the blood creatinine is frequently employed. It is the

opinion of many urologists that estimation of creatinine gives a better index of prognosis than any other test. If the blood urea is markedly elevated (80 to 100 mg) and the creatinine remains comparatively low (2 or 3 mg) the prognosis would be considerably better than if the readings for creatinine were abnormally high. It has been stated that with a blood creatinine of 10 mg or more a fatal outlook usually can be assumed. However in exceptional cases extremely high readings for blood creatinine eventually can be reduced to normal with proper treatment.

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Estimation of the blood urea probably offers the best general index of renal function. Although the concentration of urea in the normal adult is not more than 35 mg per 100 cc of blood, it is not at all uncommon to find a concentration of urea of 40 mg in adults who are more than forty years of age, without other clinical data suggestive of renal insufficiency. In fact, unless the concentration of blood urea is considerably more than 40 mg, it usually is not regarded as a barrier to surgical procedure. When the reading is more than this, however, a further check of renal function, including tests of excretion, is desirable.

As a result of renal back-pressure in the presence of obstruction at the outlet of the bladder or in the ureter, a blood urea of high concentration frequently is observed, occasionally reaching as high as 200 or 300 mg. Under these extreme circumstances, with adequate urinary drainage, dietary precautions and other methods of therapy, the renal function frequently can be brought back to normal limits. It is surprising how well surgical operations are borne by patients whose blood urea is of high concentration if the value can be reduced to a level of between 50 and 100 mg, and if the general condition of the patient is otherwise satisfactory. When observed several years later some of these patients apparently are in good health although their blood urea may remain so elevated that under ordinary circumstances it would be regarded as abnormal. Marked increase in concentration of blood urea frequently is observed in the presence of polycystic kidney and other renal lesions which are not accompanied by any subjective evidence of renal insufficiency. Unless there is evidence of urinary stasis, however, the advisability of operation is questionable.

Among the other tests of retention used in determining renal function, estimation of the blood creatinine is frequently employed. It is the

opinion of many urologists that estimation of creatinine gives a better index of prognosis than any other test. If the blood urea is markedly elevated (80 to 100 mg) and the creatinine remains comparatively low (2 or 3 mg) the prognosis would be considerably better than if the readings for creatinine were abnormally high. It has been stated that with a blood creatinine of 10 mg or more a fatal outlook usually can be assumed. However in exceptional cases extremely high readings for blood creatinine eventually can be reduced to normal with proper treatment.

Phenolsulphonephthalein.—Of the various excretory tests of renal function the rate of excretion of phenolsulphonephthalein when injected intravenously probably is the most satisfactory. The test made with the standard ampule of phenol sulphonephthalein containing 1 cc. of a 0.6 per cent solution is performed as follows. The content of the ampule is injected intravenously and the urine is collected for an hour and fifteen minutes. This interval of time has been chosen because it has been estimated that under normal conditions 40 per cent of the drug is eliminated in the first fifteen minutes approximately 17 per cent during the second fifteen minutes 5 per cent during the third fifteen minutes and 4 per cent during the fourth fifteen minutes. The average return in the second hour is about 3 per cent. A knowledge of this rate of elimination has been the means of arriving at a fractional functional determination which is particularly adaptable to patients who are being prepared for prostatectomy. A delay in the excretion of the dye in the first two fifteen minute specimens is indicative of renal disease and it may be advisable to delay surgical procedures until improved function has been restored. A slow rate of excretion of phenol sulphonephthalein should be checked by repeated studies, and errors incident to faulty drainage or to residual urine in the bladder must be corrected. The causes of such errors will be mentioned in the next paragraph. If the total excretion two hours after injection is persistently less than 60 per cent it is regarded as suggestive of renal insufficiency in the presence of medical conditions of the kidney. An excretion as low as 40 per cent is frequently observed when there are surgical lesions in the urinary tract however and has no great clinical significance. With lower readings it is usually necessary to distinguish between a condition causing retarded excretion and permanent renal damage.

A reduced excretion of phenolsulphonephthalein frequently may be the result of error in technique such as incomplete or faulty intravenous injection delay in excretion because of various anatomical factors failure to empty the bladder completely or faulty collection of urine.

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However this does not necessarily mean that because a renal pelvis is not well visualized the function is abnormal. Lack of adequate visualization may be attributable to inadequate preparation on the part of the patient, technical difficulties, hypersecretion or hyperperistalsis, or temporary dysfunction from obstruction or irritation. In some cases visualization of the ureters will be the only indication of renal function; the renal pelvis may be obscured because of the various causes enumerated. In other cases the only evidence of normal renal function may be visualization of the bladder. It may be necessary to use the data available from serial films in order to obtain any idea of the degree of renal function. With a renal insufficiency, as shown by a blood urea of 70 mg. or more, visualization of either kidney is usually incomplete and often cannot be made at all.

The excretory urogram, if correctly interpreted, offers a satisfactory routine test of renal function, both combined and differential. Unfortunately, in some cases the difficulties of interpretation are so great that it is best to rely on other tests for further information.

ROENTGENOGRAPHY

Routine roentgenography is an essential procedure in the diagnosis of lesions involving the genito-urinary tract. Although the clinical data may not be indicative of a lesion of the genito-urinary tract, a routine roentgenographic examination frequently will reveal evidence of lesions least expected. Roentgenography is specifically indicated when there is a history of pain referable to the lateral portion of the abdomen or to the suprapubic region, or when there is a history of pyuria or of hematuria in the presence of either erythrocytes or pus cells in the urine, and when a tumor is palpable in the lateral portion of the abdomen or in the suprapubic region.

Tissue Shadows.—The roentgenographic outline of the various intra-abdominal tissues may be of considerable diagnostic value. A clear outline of the kidney, which is possible with good roentgenographic technique, is often of much value in differential diagnosis, and when abnormal it may definitely indicate renal abnormality. Elongation of the renal outline is usually observed in the presence of duplication of the renal pelvis, and when this sign is present the possibility of pelvic duplication must be excluded. The outline of a fused kidney is frequently visualized in the flat film, so that the diagnosis may be surmised without urographic studies. Acquired renal dystopia is frequently visualized in the flat film, and the renal outline often can be followed when the patient is placed in the supine and later in the erect position. The stationary outline of the low ectopic kidney may be visualized and may call attention to this anomaly. A difference in the size of the two renal outlines may be caused by compensatory hypertrophy of the larger kidney. In fact, if one kidney has been removed and if there is no evidence of compensatory hypertrophic increase in size of the other, renal abnormality is suggested.

frequently are noted. This is particularly true if excretion of the dye is delayed because of urinary retention such as may occur with prostatic obstruction, hydronephrosis or polycystic kidney.

Differential Renal Function—A test of the comparative degree of function of the two kidneys is known as a "differential functional test." Evidence of reduced function of one kidney, with normal function of the other, would, of course, indicate disease. Intravenous injection of 1 cc. of phenolsulphonephthalein is most frequently employed to obtain such evidence. The catheterized specimen of urine which drains from either kidney in fifteen minutes is saved. A catheterized specimen from the bladder is then obtained and the amount of dye in the three specimens estimated. The amount of phenolsulphonephthalein in the bladder will determine the leakage alongside the ureteral catheters.

Indigo Carmine.—Chromocystoscopy with indigo carmine is primarily a qualitative and not a quantitative test of renal activity. The value of the test is based on intensity of color as judged by simple inspection of the blue color in the urine. A high concentration of indigo carmine as judged by chromocystoscopy apparently is indicative of the presence of sufficient renal substance to maintain life. However, it would seem that the number of renal units necessary to excrete enough dye to give a satisfactorily intense blue color need not be great. This is borne out clinically by the fact that a satisfactory concentration of indigo carmine is sometimes eliminated by a kidney, disease of which is rather far advanced. In such cases the disease usually is circumscribed or is limited to one portion of the kidney. Reduced elimination of dye would, therefore, give a more accurate index of renal function than a normal color. Chromocystoscopy is much more valuable as an index of the differential function of the two kidneys than as a combined test, and as such is widely employed. Indigo carmine is used also as a means of locating the ureteral meatuses when difficulty in identifying them is experienced, especially in the presence of tuberculosis of the bladder.

A frequent cause of low elimination of dye is not so much failure of the kidneys to secrete as delay in excretion. Owing to the possibility of obstruction of the renal tubules, such as occurs in the presence of polycystic kidney, or of obstruction in the pelvis or ureter, such as occurs with ureterectasis and pyelectasis, there may be marked delay in elimination. Reflex inhibition of secretion, occurring in the presence of stone, also is well known. Any obstruction in the lower portion of the ureter, such as may be caused by lithiasis, neoplasm in the bladder or ureter, or edema of the ureteral mucosa, also may interfere with normal excretion of dye.

Excretory Urography as a Test of Renal Function.—Visualization of the pelvis, ureter and bladder by means of excretory urography, if the result is correctly interpreted, will give an accurate index of the degree of renal function. It may be stated that any renal pelvis clearly visualized at the end of five minutes must be normal in function.

However this does not necessarily mean that because a renal pelvis is not well visualized the function is abnormal. Lack of adequate visualization may be attributable to inadequate preparation on the part of the patient, technical difficulties, hypersecretion or hyperperistalsis, or temporary dysfunction from obstruction or irritation. In some cases visualization of the ureters will be the only indication of renal function; the renal pelvis may be obscured because of the various causes enumerated. In other cases the only evidence of normal renal function may be visualization of the bladder. It may be necessary to use the data available from serial films in order to obtain any idea of the degree of renal function. With a renal insufficiency, as shown by a blood urea of 70 mg. or more, visualization of either kidney is usually incomplete and often cannot be made at all.

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Unilateral increase in the size of a kidney often results from neoplasm. The enlargement caused by tumor frequently is confined to one portion of the kidney, which may be abnormally broadened and irregular in outline. When a tumor is of extrarenal origin, the independent renal shadow often is visualized. In some cases the renal shadow is displaced and deformed by pressure from the extrarenal tumor. It must be remembered that shadows which simulate those of the kidney may be present and can be a source of confusion.

Among other roentgenographic data which would be of value in the differential diagnosis of lesions of the urinary tract may be mentioned the following: spondylolisthesis, or spina bifida occulta, which may occur as etiological factors in cases of atonic bladder, evidence of vertebral, osseous or pulmonary tuberculosis, which is often coincident with genito-urinary tuberculosis, obliteration of the shadow of the psoas muscle or scoliosis, which often is observed with perinephritic abscess, osteoporosis, which may occur with parathyroid disease and recurring renal calculi, osseous or pulmonary metastasis secondary to carcinoma of the prostate, bladder or kidney, and elevation of the diaphragm, which frequently occurs with perinephritic abscess or with renal tumor.

Urinary Lithiasis.—It has been said that the roentgenogram never lies, but if one were to believe everything it says, the clinician frequently would be led into error. In other words, every shadow apparently situated in the region of the kidney, ureter or bladder does not necessarily indicate that it has its origin in these tissues. Given a shadow in the roentgenogram, the next step is its identification. This usually is made best by urography, either excretory or, if necessary, by the retrograde method combined with cystoscopy.

The question frequently is raised whether a calculus which has been missed by the roentgen-rays may be present. Although with improved roentgenographic technique the percentage of failure in visualizing urinary calculi is rapidly diminishing, nevertheless stones of low-calcium content situated in any portion of the urinary tract are overlooked occasionally. This probably occurs most frequently when small stones of recent formation are situated in the lower part of the ureter and when stones are in the bladder. Urography occasionally will disclose the existence of stones of low-calcium content by making evident filling defects or other deformity in the outline of the renal pelvis. Calcification of the tissues, such as occurs with tuberculosis of the genito-urinary tract, may be a source of confusion. Such calcification may be localized in any portion of the tract, but the kidney is the most frequent site. In fact, evidence of calcification suggestive of tuberculosis will be found in approximately 20 per cent of flat films made of patients who have renal tuberculosis. It should be remembered that shadows suggestive of lithiasis, which are caused by calcification in renal neoplasms, may also appear in the region of the kidney. Shadows in the region of the bladder occasionally are seen in the presence of incruled cystitis or when there are calcareous in-

crystallizations on a vesical neoplasm. Stones which do not cause pain or any other symptom are frequently found in various portions of the genito-urinary tract. They have been called "silent stones" and are usually overlooked unless the routine roentgenogram reveals their presence.

UROGRAPHY

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Ability to interpret the urogram is of course essential to exact diagnosis. Familiarity with the outline of the normal pelvis, calices and ureter is essential to exact interpretation. Although gross changes subsequent to stasis and lithiasis usually can be recognized even by the person with limited experience, it often requires skill in urographic interpretation to recognize the significance of minor deformities. When visualization of the pelvis and ureter is fragmentary, urographic interpretation, even with wide experience, may be extremely hazardous and usually should not be relied on. The various types of abnormality which may be visualized are those resulting from malposition, stasis, infection, neoplasm, trauma and anomaly.*

Confusion in interpretation may arise from errors in radiographic technique, such as inadequate preparation of the patient, movement in the course of exposure of the film, insufficient filling or overdistention of the renal pelvis or ureter with the opaque medium, and errors in roentgenographic technique. Apparent filling defects in the pelvis or ureter may be caused by hyperperistalsis, inadequate distention of

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the pelvis, or blood clots, and the urogram should be repeated to exclude such errors. In making the retrograde urogram, every precaution should be taken not to overdilate the pelvis, and injection should be stopped as soon as the patient complains of the slightest discomfort. Overdistention, with extravasation, may cause deformity which is very suggestive of disease. On the other hand, unless the pelvis is completely dilated, apparent deformity may result which is easily confused with abnormality. Occasionally, when the pelvis is incompletely visualized by the retrograde method, the excretory urogram will outline it completely. The reverse is also true. With excretory urography, a marked difference may be noted between the rapidity with which the renal pelvis of one patient, and that of another, empties itself. If the pelvis or ureter is spastic, the outline of either may be only partially visualized. In case there is stasis in the renal pelvis, media injected in the course of retrograde urography may be retained and may become a source of irritation and secondary infection. Although such irritation has been largely eliminated by the use of the newer media now employed, particularly any of the various organic iodides, yet occasionally it is observed if the media is retained for a long time. For this reason the excretory urogram is preferable for use as a routine procedure in the presence of evident stasis. As a matter of precaution it is advisable to permit the ureteral catheter to drain the pelvis thoroughly, and later to perform lavage of the pelvis with sterile fluids. If, in spite of this precaution, clinical evidence of acute renal infection should develop, surgical interference should not be delayed.

Interpretation of the ureterogram may be difficult, particularly when visualization is incomplete, as frequently occurs with excretory urography. One portion of the ureter may be better visualized in one film than in others of the series, and a better idea of the pelvic outline is frequently obtained by combining the data available from the various films. Inadequate visualization of the pelvis, calices and ureter, which often occurs with excretory urography, may be attributable to excessive peristalsis or technical factors. Clear visualization of one renal pelvis and poor visualization of the other does not necessarily indicate a lesion of the latter. A slight difference in the extent and intensity of visualization of the two normal pelves is often observed. Marked delay or absence of visualization, however, usually indicates disease. Delay in time of pelvic drainage indicates stasis from actual obstruction. Complete failure of visualization on one side in repeated films must be interpreted as indicative of renal dysfunction. It is important to determine whether this dysfunction is attributable to some temporary lesion or irritant, or whether the renal tissue is really destroyed. With failure of visualization it is often advisable to corroborate evident dysfunction by means of cystoscopy and chromocystoscopy, and possibly by means of a retrograde pyelogram.

Adequate preliminary preparation should obviate the technical factor in poor visualization of the urinary tract. Attention to proper

elimination of intestinal content restriction of the intake of food and fluid for twelve hours preceding the examination and appropriate pressure over the region of the lower parts of the ureters may enhance the detail of the urogram.

Excretory urography has been of great value when applied to children particularly male infants, in examination of whom the difficulty of adequate cystoscopy is apparent. Intravenous injection of the young child may be difficult and in some cases may require preliminary anesthesia. Although the resulting urogram is not always



Fig. 50.—Bilateral hydronephrosis—more marked on left

satisfactory because of the presence of intestinal gas and hyperperistalsis, yet in most cases visualization of urinary stasis, marked deformity or unilateral dysfunction is feasible.

Pyelectasis.—In the presence of pyelectasis the relative degree of visualization of the calyces and renal pelvis varies widely. In most cases pyelectasis can be recognized best by means of excretory urography (Fig. 56). Exceptions to the rule, however, occur when the kidney fails to excrete sufficient iodine to allow of visualization of the pelvis and when with minor degrees of pyelectasis the peristalsis is so rapid that the full degree of dilatation of the pelvis or calyces is not visualized. If there is any doubt as to the presence of stasis in the renal pelvis such as may occur with minor degrees of pyelectasis it is advisable to make a retrograde urogram with a delayed film. Since

injected media usually are evacuated from the normal pelvis within ten or fifteen minutes after the ureteral catheter has been withdrawn, if a film made twenty or thirty minutes after injection gives evidence of retention of media, inadequate renal drainage is evident. If such films are made with the patient in the erect and in the supine positions, evidence of postural influence on position of the renal pelvis as well as on drainage may be visualized. Serial films always should be made in this manner in cases of renal dystopia.

Ureterectasis —To visualize dilatation of the ureter often is difficult because of excessive peristalsis. Even when precautions are taken to



FIG 57 —Filling defect from tumor of lower left ureter, with pyelo-ureterectasis

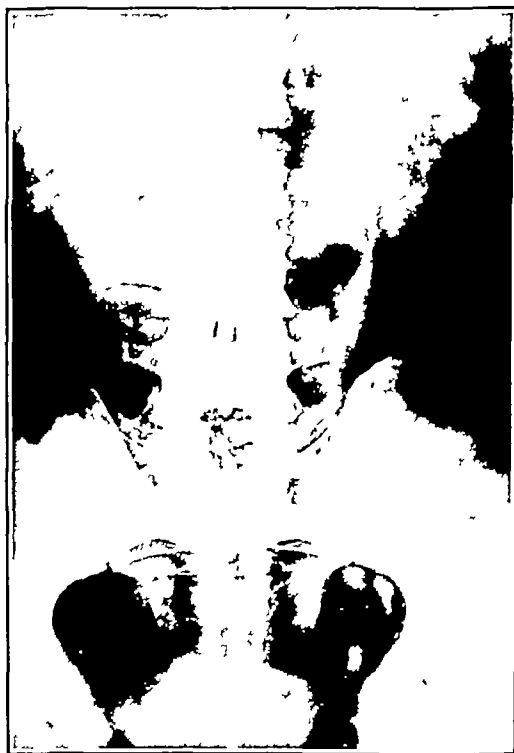


FIG 58 —Stone in left kidney multiple stones in lower left ureter

compress the lower part of the ureter and to have the patient in the erect position just prior to roentgenographic exposure, visualization of the ureter, particularly its lower half, may be difficult. It may be impossible to distinguish the ureterectasis caused by obstruction from that of inflammatory origin, and the confusion may be increased when both etiological factors are present (Fig 57). In general, it may be said that the degree of ureterectasis is greater, and the outline of the ureter more regular, when obstruction is the etiological factor. With marked ureterectasis the retained urine may dilute the pyelographic medium so that the ureteral outline is indistinct. Unilateral or bilateral ureterectasis, particularly in the lower portion, may be

demonstrated by filling the bladder with opaque medium and with the patient in the Trendelenburg position allowing it to be regurgitated up the ureter. Visualization of the entire ureter usually is unsatisfactory in the excretory urogram unless serial exposures are made. For this reason it is often necessary to assemble data from several films in order to obtain an idea of the ureteral outline. Ureterectasis of considerable degree is easily overlooked unless there is actual obstruction or retention of urine in the ureter at the time of roentgenographic exposure. A diagnosis of ureteral stricture, a condition which until very recently has been regarded as of common occurrence, cannot be made without demonstrating ureterectasis above it. This is also true with so-called kinks in the ureter. The absence of any evidence of ureterectasis in the ureterogram would exclude both of these lesions.

Nephrolithiasis. Although most of the roentgenographic shadows in the region of the kidney may be identified by their contour, character and position, yet the shadow of renal stone is frequently atypical and may be easily confused with shadows caused by extrarenal calcification. In most cases identification is possible by means of excretory urography, although occasionally additional data given by cystoscopic examination and retrograde urography may be necessary (Fig. 18). The pyelographic data which will make possible determination of whether a shadow is intrarenal or extrarenal are: (1) the distance separating the shadow from the pelvic outline; (2) the exact relationship of the shadow from the pelvic outline; and (3) the presence of pathological changes in the pelvic outline. Roentgenogram taken from the lateral aspect are often of considerable value in the diagnosis of questionable shadows.

When the distance between a shadow in question and the shadow of a calyx is more than 4 cm. the former shadow should be regarded as being extrarenal. The degree of deformity of the pelvic outline is not dependent on the size of a stone. Frequently a comparatively small stone may be accompanied by considerable deformity. Again there may be but little deformity when the stone almost fills the pelvis. When dilatation occurs secondary to stone in the kidney, the distention is most marked in the calices and the immediate cause usually is secondary inflammation rather than obstruction. If the dilatation is greatest in the pelvis, the stone usually is secondary to hydronephrosis. Occasionally the dilatation caused by the presence of stone may be confined to one or more calices leaving the other calices and the pelvis comparatively normal.

The urogram will not only identify and localize the shadow in question but it will in addition visualize the existence of coincident renal and ureteral deformity. The excretory urogram also will indicate the degree of impairment of renal function on the affected side and the degree of function on the other side. In most cases of nephrolithiasis the surgeon will require no other data than those furnished by the excretory urogram. However further data including cystoscopy usually will be necessary when visualization is absent or incom-

injected media usually are evacuated from the normal pelvis within ten or fifteen minutes after the ureteral catheter has been withdrawn, if a film made twenty or thirty minutes after injection gives evidence of retention of media, inadequate renal drainage is evident. If such films are made with the patient in the erect and in the supine positions, evidence of postural influence on position of the renal pelvis as well as on drainage may be visualized. Serial films always should be made in this manner in cases of renal dystopia.

Ureterectasis.—To visualize dilatation of the ureter often is difficult because of excessive peristalsis. Even when precautions are taken to



FIG 57 —Filling defect from tumor of lower left ureter, with pyelo-ureterectasis



FIG 58 —Stone in left kidney, multiple stones in lower left ureter

compress the lower part of the ureter and to have the patient in the erect position just prior to roentgenographic exposure, visualization of the ureter, particularly its lower half, may be difficult. It may be impossible to distinguish the ureterectasis caused by obstruction from that of inflammatory origin, and the confusion may be increased when both etiological factors are present (Fig 57). In general, it may be said that the degree of ureterectasis is greater, and the outline of the ureter more regular, when obstruction is the etiological factor. With marked ureterectasis the retained urine may dilute the pyelographic medium so that the ureteral outline is indistinct. Unilateral or bilateral ureterectasis, particularly in the lower portion, may be

strated in the outline of the pyelogram. The minor deformities in the renal pelvis and calices which usually result from chronic renal infection are often incompletely visualized in the excretory urogram and can then be shown only in the retrograde urogram. However comparative variation in visualization of the two kidneys and evidence of a moderate degree of unilateral stasis may be suggestive of unilateral renal disease when other data are of doubtful value.

Renal Tuberculosis.—When the diagnosis of renal tuberculosis is uncertain from the clinical data available the pyelogram frequently gives easily recognizable evidence of deformity and permits of a positive diagnosis. In the presence of tuberculosis the changes which may be detected in the pyelogram are as follows: regions of cortical necrosis; dilatation of the pelvis or of individual calices; obliteration of one or more calices; and single or multiple strictures of the ureter. Dilatation with evidence of stricture of the ureter may be regarded as only presumptive evidence, whereas evidence of cortical necrosis is pathognomonic of renal tuberculosis. The first evidence of cortical necrosis occurs just beyond the ends of the calices and is characterized by irregular detached shadows of medium. As the inflammatory process extends the necrotic portions become larger and may cause irregular shadows adjacent to the pelvic outline or they may appear as irregular shadows scattered in various portions of the cortex. Again the regions of necrosis may appear to communicate by narrow isthmus directly with the outline of the pelvis. Although the excretory urogram may not clearly visualize these details it is usually of great aid in the diagnosis of tuberculosis. The following urographic evidence of disease may be regarded as suggestive of tuberculosis: (1) Absence or marked delay in visualization of the affected kidney. (2) pyelectasis or ureterectasis, with an irregular outline. (3) failure of visualization of one or more calices with irregularity of the pelvic outline. (4) definite necrosis on one side and a normal pelvis and ureter on the other. It should be stated that normal visualization on one or both sides does not exclude renal tuberculosis. Although excretory urography usually should be employed as a routine preliminary measure it would not be advisable to rely entirely on the evidence it offers except in those cases in which cystoscopy and ureteral catheterization would be difficult or inadvisable.

Renal Neoplasm.—Deformity visualized in the urogram in the presence of tumor of the kidney is usually characterized as follows: (1) Elongation of one or more of the calices usually with narrowing. (2) encroachment on the pelvic lumen varying from minor deformity to complete obliteration. (3) secondary pyelectasis. (4) displacement or torsion of the renal pelvis and (5) deformity at the ureteropelvic juncture.

Probably the earliest deformity of the pelvis caused by renal tumor is elongation of one or more calices. As the tumor enlarges toward the periphery it stretches the affected calices with it often to unusual length. The resulting deformity of the pelvic outline in the pyelogram

plete because of reflex irritation or obstruction to drainage, when the exact relation of the shadow of the stone to the outline of the pelvis or calices is not apparent, and in the presence of marked pyuria or hematuria

Renal Infection —Pyelectasis and ureterectasis of moderate degree may be caused by infection involving the renal pelvis and ureter (Fig 59) The extent of the dilatation depends on the severity and duration of the infection Evidence of an inflammatory process is



FIG 59 —Functionless left kidney, marked inflammatory dilatation of right renal pelvis, calices and ureter

demonstrated in the pvelogram by the following characteristics (1) Obliteration of the terminal irregularities of the minor calices, so that they appear clubbed, (2) dilatation of the calices of more marked degree than that of the true pelvis, and (3) irregularity of outline of the pelvis and calices When the process in the pelvis results in marked destruction of tissue, irregular dilatation of the entire pelvis may result, such as occurs with pyonephrosis However, when the destructive process is not balanced by proliferation of tissue, a small, atrophic kidney may result, and there is considerable contraction of the pelvic outline Urography offers a means of recognizing pyelonephritis and the extent of the process, together with the functional capacity of the remaining renal tissue When the process has gone on to healing, a healed pyelonephritic lesion frequently can be demon-

kidney are normal polycystic disease can be excluded. The changes in the outline of the renal pelvis which may occur with polycystic kidney are as follows: (1) Broad irregular extension of the calices with irregular enlargement in the terminal portion (2) partial obliteration of the pelvis or calices as a result of extension or compression of the cyst (3) compression by cysts of one or more calices causing them to assume a circular or semicircular outline (4) change in position and axis of the pelvis and (5) inflammatory changes consequent to secondary infection.

Deformity in the outline of the pelvis resulting from so-called simple cyst of the kidney is quite different from that encountered in polycystic disease and usually is characterized by the following changes: (1) Abbreviation or compression of the adjacent calices (2) compression and flattening of the adjacent portion of the pelvis and (3) change in position and axis of the kidney as the result of displacement or of increased weight in one pole. It may be difficult to distinguish the pelvic deformity from that caused by renal neoplasm, polycystic disease or pressure from extrarenal tumor. A normal pyelogram would not necessarily exclude the presence of a small cyst since the cyst may be situated so as to cause little or no deformity of the renal pelvis.

Anomaly—Renal anomaly is usually visualized by the excretory urogram although minor details of deformity and evidence of stasis are sometimes best demonstrated by the retrograde pyelogram. As a result of widespread routine employment of excretory urography the clinical diagnosis of congenital anomaly in the upper part of the urinary tract has become much more frequent. It is possible to ascertain not only the presence of anomaly by means of pyelography but also the existence of complicating pathological conditions.

Among the anomalies in the upper part of the urinary tract that may be demonstrated by pyelo-ureterography are duplication of the renal pelvis and ureter, renal fusion and ectopic kidney.

Duplication of the Renal Pelvis and Ureter—Duplication of the pelvis may be partial or complete, bilateral or unilateral and may vary in degree from abnormal elongation of a widely separated calix to two distinct and widely separated pelves (Fig 60). The outline of the upper pelvis is usually small and high-lying in comparison with the larger lower pelvis. If a pelvis of one of the types just described is visualized the possibility of a duplicated pelvis must always be considered (Figs 61 and 62).

Duplication of the ureter may be complete or partial, bilateral or unilateral. The two ureters when completely duplicated usually are seen to cross twice before they enter the bladder, first a short distance below the ureteropelvic juncture and again a short distance above the bladder. The ureter which extends to the lateral and posterior meatus will be found to lead from the lower of the two renal pelvis, whereas the ureter which extends to the medial meatus leads from the upper renal pelvis. In the presence of partial duplication of the ureter the

has been designated as a "spider-leg" deformity. When the tumor is confined to either pole of the kidney, elongation may be confined to the adjacent calix. The number of calices involved, as well as the extent of elongation, increases with the size of the tumor. When multiple calices are affected, the larger portion of the kidney usually is involved. This type of deformity is most commonly observed in the presence of adenocarcinoma. When the tumor originates in the pelvis of the kidney it either will occlude its lumen or cause pyelectasis. The resulting deformity usually involves the pelvis more than the individual calices, so that the elongation and obliteration of the calices which occur with cortical tumor are not, as a rule, observed. Pyelectasis in the presence of, or with a history of, previous hematuria, should suggest the possibility of papillary epithelioma of the renal pelvis.

Among the many sources of error which may arise in interpretation of the pyelogram in cases of suspected renal tumor, the following may be enumerated: (1) Obstruction at the ureteropelvic junction with inability to distend the pelvis of the kidney and ureter sufficiently, (2) dilution of the injected fluid with urine retained in the pelvis, (3) obscuring of the pelvic outline by overlying tumors, (4) the presence of deformity too slight to be recognized, and (5) incomplete visualization in the excretory urogram. Occasionally a clot of blood in the pelvis or upper part of the ureter may cause a filling defect which closely resembles pelvic deformity caused by tumor and which frequently has been mistaken for such deformity. An extensive clot may almost obliterate the pelvic lumen, causing irregular streaks in the pyelogram, attributable to the opaque medium settling adjacent to the walls or in crevices within the clot. In doubtful cases it is well to repeat the pvelogram several days after the hematuria has ceased.

Pyelography is of considerable value in determining the cause of renal hematuria. In the differential diagnosis of obscure renal neoplasm, on the one hand, and of chronic renal infection with hematuria or the so-called essential hematuria, on the other, pyelography may be the only method available. Demonstration of a normal pelvis would, in most cases, exclude renal neoplasm. Urography is particularly useful in the identification of abdominal tumors when the previous history of hematuria has been indefinite or uncertain and when examination of the urine is negative or demonstrates only a few abnormal elements. A recent review of the urographic evidence available in a series of cases of neoplasm disclosed that the excretory urogram sufficed to make the diagnosis in 80 per cent. However, when the details of the minor calices are not clearly visualized, a retrograde urogram always should be made if the possibility of neoplasm is considered.

Renal Cysts—Since polycystic disease is probably the result of congenital renal defect, abnormality of the renal pelvis is always bilateral. Occasionally the deformity in one kidney is very slight and is not easily recognized in the excretory urogram. When the nature of the deformity is doubtful, it is advisable to make a retrograde pvelogram of both kidneys, and if the pelvis and calices of one

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two ureters may unite at any level below the hilum although they join most frequently in the lower third of the ureter.

The existence of stasis, lithiasis, or infection in either of the duplicated pelvises or ureters may be overlooked on roentgenographic or cystoscopic examination unless the presence of duplication is recognized.

Renal Fusion.—Although renal fusion may be suggested by the contour and position of the kidneys in the flat film, nevertheless more accurate data are obtained by means of urography. In most cases at least one of the two pelvises will be situated either close to the vertebral column or overlying it to a variable degree. Not infrequently both pelvises are seen to be symmetrically situated near the vertebral column. Evidence of incomplete rotation, as shown by the median and anterior axis of the calices in both pelvises, will call attention to the nature of the lesion (Fig. 63). The ureter, instead of leading from the lateral



FIG. 63.—Horseshoe Kidney

portion of the pelvis will arise from the anterior or median angle. Often a slight degree of pyelectasis accompanies renal fusion, but there may be no other evidence of stasis and there may be no symptoms. Renal torsion or incomplete rotation may sometimes simulate the pelvic deformity observed with renal fusion. As a rule, however, renal torsion is unilateral and the relation of the affected pelvis to the other one will exclude the possibility of fusion.

Ectopic or Pelvic Kidney.—The ectopic kidney usually is fixed in the bony pelvis or at a slightly higher level and is usually recognized by its position and by the bizarre appearance of the pelvis and calices. As a result of incomplete rotation, many of the calices extend in an anterior and median direction and a slight degree of pyelectasis is frequently present. The outline of the pelvis is frequently obscured by the outline of the vertebrae and may be easily overlooked. As a rule, the distance between the pelvis of an ectopic kidney and the pelvis of a normally situated kidney will prevent confusing of the condition with that of renal fusion.



FIG 60 — Complete duplication of left pelvis and ureter



FIG 61 — Upper of duplicated pelvis



FIG 62 — Duplication on right of interest is the distance separating the two pelvis

in the presence of a tumor in the bladder because of profuse hemorrhage, intolerance of the patient to instrumentation, vesical contraction or deformity. In such cases a cystogram may reveal the extent and situation of the neoplasm and may aid in determining the proper treatment. The outline of a bladder which contains a neoplasm is characterized by an irregular filling defect at the site of the tumor. The extent and situation of the filling defect usually will vary with the thickness and size of the tumor although occasionally the tumor is more extensive than the deformity would indicate. It should be



FIG. 61.—Large stone in ureter, also multiple vesical diverticula.

noted that in some cases of hemorrhage blood clots in the bladder may produce filling defects in the cystogram which may simulate the deformity caused by tumor. The site and extent of tumors which involve the sphincter may be difficult to determine by means of cystoscopy and then can be more accurately ascertained by cystography. Generally when the filling defect is extensive and involves most of the outline of the bladder the condition may be regarded as inoperable. However a large pedunculated tumor particularly of the benign type may cause an immense filling defect and give a false impression that the tumor is inoperable.

Prolonged inflammation of the bladder such as that which occurs secondary to pyelonephritis or renal tuberculosis usually causes marked vesical deformity. The resulting outline in the cystogram appears small, contracted and irregular. A similar deformity can be seen in a cystogram made of a bladder which is being continuously drained by an indwelling catheter.

Cystography — Roentgenographic visualization of the bladder following distention with opaque media or with air, a division of urography, is known as "cystography." It has been found to be of considerable value as an aid to cystoscopy in ascertaining data which cannot be acquired by cystoscopy alone and when the condition of the patient or difficulties of instrumentation preclude cystoscopy. It is of particular value in the study of vesical tumor, diverticulum, the contour of the bladder, evidence of deformity from extravesical pressure and ureteral reflux or regurgitation. Since the development of transurethral resection of the prostate, it has been used to determine the type and extent of obstruction at the vesical neck. The medium of choice at present is a 10 or 15 per cent solution of any of the organic forms of iodide now available. The technique of making serial cystograms at different angles after distending the bladder with opaque media, and again when the bladder has been emptied by catheterization is still the most satisfactory one.

The outline of the normal bladder varies considerably in shape and size. It may be circular, oblong, pyramidal or pear-shaped, and varies in diameter from 8 cm. to considerably more. A smooth, regular outline is indicative of a normal bladder. Irregularity caused by trabeculation or cellules is readily recognized in the outline of the bladder. The base usually appears just above the symphysis pubis. In infants the bladder is proportionately larger and appears higher in the pelvis.

Probably in recognition of no lesion of the bladder are cystographic data so important as in recognition of diverticulum (Fig. 64). Although diverticula may be diagnosed by cystoscopic examination, they are easily overlooked in examination of an infected or deformed bladder. Furthermore, the exact size of the diverticulum, and its relation to the ureter, may also be ascertained by this means. Cystography also affords a means of determining the degree to which a diverticulum drains when the bladder is emptied. Localization of stone or neoplasm in a diverticulum is also possible by this method. It should be remembered that sacculation or bulging of the wall of an atonic bladder may cause irregularity in the vesical outline which is very suggestive of diverticulum.

The employment of cystography before operation in many cases of prostatic hypertrophy is preferable to routine cystoscopy. It frequently will visualize deformity, knowledge of which may be of considerable value in subsequent treatment. The degree and type of deformity at the vesical neck, caused by prostatic hyperplasia, varies widely. A variable degree of elevation of the base of the bladder is usually seen in the presence of marked commissural or intravesical prostatic hyperplasia. The degree of elevation, however, is not necessarily commensurable with the size of the prostate. Regurgitation of the opaque medium into one or both ureters, to a variable distance, is also frequently visualized.

It may be impossible to make a satisfactory cystoscopic examination

Urethrocytography — Since lesions involving the posterior urethra, prostate and vesical neck are often intimately associated, the combined method of urethrocytography may afford a means of visualizing the nature of the lesion (Fig. 6.) The method has its limitations as a diagnostic procedure and should be considered only as a procedure that is supplementary to cysto-urethroscopic examination. Urethrocytography is particularly applicable to the demonstration of stricture of



FIG. 6. — Cysto-urethrogram: contracted bladder with chronic bilateral pyelonephritis and ureteritis. Multiple diverticula in urethra, with incontinence.

the urethra, diverticulum and fistula of the urethra, and relaxed internal sphincter. The method has become particularly widely used as a means of providing a graphic study of the results of prostatic resection. While functional results attest to the final value of the operation, nevertheless an outline of the vesical neck may give evidence of insufficient removal of prostatic tissue or of filling defects which may warrant further correction.

Pressure on the bladder from adjacent structures, with resulting deformity, may be demonstrated in the cystogram. Cystography may also be of some aid occasionally in recognition of extravesical lesions. Tumors of the uterine cervix may cause elevation of the base of the bladder, similar to that observed with prostatic hypertrophy. As the result of pressure from tumor of the body of the uterus, there may be a distinct filling defect in the outline of the dome of the bladder, similar to that produced by vesical neoplasm. As a rule, however, the filling defect in the presence of neoplasm is very much more irregular. Tumors which arise from the prostate or seminal vesicles may cause rather marked displacement and deformity of the outline of the bladder. Similar displacement may result from perivesical abscess, the deformity simulates, but, as a rule, is not so irregular as that which occurs with neoplasm of the bladder. In examination of huge inguinal hernias, if the examiner is uncertain of the scrotal content, a cystogram may be of value in excluding or demonstrating hernia of the bladder.

In normal persons the mechanism of the ureterovesical juncture is so regulated that the content of the bladder does not flow back into the ureter. However, this often occurs with ascending infections of the ureter from chronic cystitis and retention, and when it does occur, regurgitation can be demonstrated by means of cystourography. The term "regurgitation" has been used to denote the passage of the content of the bladder into the ureter or kidney under normal conditions. The term "reflux" describes the passage of medium from the bladder into the ureter as a result of either loss of tone of the musculature of the bladder and ureter, obstruction at the neck of the bladder, or disease of the spinal cord. However, the two terms are used rather interchangeably.

Disease or injury of the spinal cord frequently causes rather typical deformity in the outline of the bladder and the vesical neck, the condition is known as "cord bladder" or "neurogenous bladder." Cystography is often of aid in making the diagnosis. The following changes in the cystogram, incident to cord bladder, may be noted: a large, comparatively even outline, relaxation of the internal sphincter as indicated by regurgitation from the bladder of medium into the posterior urethra, and frequently ureteral regurgitation.

Excretory cystography is frequently of value and the outline of the bladder always should be noted in the course of routine excretory urography. It has often demonstrated the presence of vesical neoplasm, diverticulum or other deformity which might otherwise be overlooked. Occasionally, when there is complete absence of visualization of the upper part of the urinary tract, the presence of the excreted medium in the bladder may be the only evidence of adequate renal function. Excretory urography also affords a means of estimating the amount of urinary retention when it is not feasible or desirable to carry out catheterization or other retrograde studies.

2 **Location.**—Urethral chancre is located either at the meatus (chancre of the meatus) or more deeply in the interior of the urethral canal (endo-urethral chancre)

A **CHANCRE OF THE MEATUS**—Chancre of the meatus may make its appearance in the following ways

1 Round chancre embraces all of the free extremity of the canal. This form presents itself under the aspect of a small rose-colored circle hemming in the meatus and leaving the urethra projecting like a beak on the surface of the glans

2 Left or right hemilateral chancre occupies the corresponding lip of the meatus; it appears under the form of a projecting nodule which provokes a deformation of the meatus by retraction of the corresponding lip or side on which the chancre is located

3 Superior or inferior comminural chancre occurs in the form of a crescent, the corners of which descend or ascend more or less on either of the two lips of the meatus or on both

These three types of chancre during the course of their evolution may lose the primitive characteristics which differentiate them from each other, particularly when phagedena is a complication

Symptoms.—Syphilitic chancre of the meatus may be either erosive or ulcerative. Induration is marked and often diffuses toward neighboring structures.

When the chancre is situated exactly on the meatus, whether or not it extends into the canal, the orifice is swollen, deformed, red and gaping, bleeding on pressure and offering to the touch a sharply circumscribed indurated area

In women syphilitic chancre of the meatus usually has its site at the inferior angle of the orifice. Simoneseu³ cites a case in which the chancre, primarily located at the meatus, sank into the urethra up to the vesical neck

B **ENDO-URETHRAL CHANCRE.**—While endo-urethral chancre is not common, it is far from uncommon. Occurring in the fossa navicularis portion of the urethra, as it does many times, it is unrecognized. Often it is so near the meatus that it can be seen by forcibly separating the borders of the urethral orifice. Du Castel¹⁴ observed one situated 2 cm. behind the fossa navicularis. Lasoli¹⁵ cites one situated 2½ cm. from the meatus on the inferior wall of the urethra

Endo-urethral chancre occurs in the following ways

1 From a chancre at the meatus extending by continuity. The endo-urethral chancre of the anterior portion of the urethra is only an extension of the chancre of the meatus

2 Sometimes in patients afflicted with gonorrhea the mucous membrane in the fossa navicularis becomes eroded, producing a point of entrance for the spirochetes

3 It is possible, but highly improbable, that infection may take place by the passage of sounds into the urethra. Cases of this type have been reported, but in this day of asepsis and antiseptics such an accident is almost beyond belief

CHAPTER III

SYPHILIS OF THE GENITO-URINARY ORGANS

By B. C. CORBUS, M. D., F. A. C. S.

SYPHILIS OF THE URETHRA

THE *Spirochæta pallida* may invade the urethra in either the primary, secondary, or tertiary periods, and provoke lesions which on account of their site, form, and evolution may produce a variety of more or less obscure symptoms.

In 1897 appeared the first review of syphilis of the urethra, by Fairout,¹ followed later (1898) by the thesis of Bellet,² and still later (1905) by the general review of syphilis of the urethra, by Simionescu.³ In 1908 the thesis of Rougier,⁴ on tertiary syphilis of the urethra, followed by the general review of syphilis of the urethra, by Tanton,⁵ added materially to our knowledge of these conditions.

Primary Syphilis —1 **Frequency** —Fournier⁶ reports that out of 414 indurated chancres, 32 occurring at the meatus, 17 were deep and could easily have escaped notice. In women urethral chancre is much more infrequent than in men. According to Fournier,⁷ the order of frequency in women is as follows: entrance to the vagina, region of the clitoris, uterine neck, and urethra.

The fact that clinicians are still interested in reporting their unusual cases of syphilis of the urethra is indicated by a review of the literature. In 1929 Gouin and Daoulas⁸ reported the case of a woman with intra-urethral chancre, inoculation having been due to the introduction of a contaminated cannula by a physician. In this case the Wassermann reaction was negative for a long time. These authors state that they have found intra-urethral chancre to be rare in women and difficult to diagnose. Bortulucci,⁹ in 1931, reported the case of a woman who had an indurated primary syphiloma at the beginning of the vaginal canal along the urethral-vaginal septum. The diagnosis was arrived at through the presence of syphilitic fever with cutaneous macular syphiloderma. A case of syphilitic reinfection in a man, aged nineteen years, was reported by Sergiescou.¹⁰ In 1921 the patient had been treated for syphilis and cured, the primary syphilis having been manifest on the dorsum of the penis. In 1930 the patient contracted a new syphilitic infection and the chancre was located on the urethral meatus. Femberg,¹¹ in 1932, reported a case of chancre of the female meatus with total occlusion. The chancre was indurated and the size of a penny, covering the meatal lips completely. The Wassermann reaction was 4+, numerous spirochetes were found. Other cases of intra-urethral chancre have been reported by Trost,¹² Zollschan,¹³ Koesun,¹⁴ Rodin,¹⁵ Riba,¹⁶ Lapschew,¹⁷ and others.

2 **Location.**—Urethral chancre is located either at the meatus (chancre of the meatus) or more deeply in the interior of the urethral canal (endo-urethral chancre)

A **CHANCRE OF THE MEATUS**.—Chancre of the meatus may make its appearance in the following ways

1 Round chancre embraces all of the free extremity of the canal. The form presents itself under the aspect of a small rose-colored circle hemming in the meatus and leaving the urethra projecting like a beak on the surface of the glans

2 Left or right hemilateral chancre occupies the corresponding lip of the meatus; it appears under the form of a projecting nodule which provokes a deformation of the meatus by retraction of the corresponding lip or side on which the chancre is located

3 Superior or inferior commissural chancre occurs in the form of a crescent the corners of which descend or ascend more or less on either of the two lips of the meatus or on both

These three types of chancre during the course of their evolution may lose the primitive characteristics which differentiate them from each other particularly when phagedena is a complication

Symptoms.—Syphilitic chancre of the meatus may be either erosive or ulcerative. Induration is marked and often diffuses toward neighboring structures.

When the chancre is situated exactly on the meatus whether or not it extends into the canal the orifice is swollen deformed red and gaping bleeding on pressure and offering to the touch a sharply circumscribed indurated area

In women syphilitic chancre of the meatus usually has its site at the inferior angle of the orifice. Simonescu³ cites a case in which the chancre primarily located at the meatus sank into the urethra up to the vesical neck

B **ENDO-URETHRAL CHANCRE.**—While endo-urethral chancre is not common it is far from uncommon. Occurring in the fossa navicularis portion of the urethra as it does many times it is unrecognized. Often it is so near the meatus that it can be seen by forcibly separating the borders of the urethral orifice. Du Castel¹⁴ observed one situated 2 cm. behind the fossa navicularis. Lasoli¹⁵ cites one situated 2½ cm. from the meatus on the inferior wall of the urethra

Endo-urethral chancre occurs in the following ways

1 From a chancre at the meatus extending by continuity. The endo-urethral chancre of the anterior portion of the urethra is only an extension of the chancre of the meatus.

2 Sometimes in patients afflicted with gonorrhea the mucous membrane in the fossa navicularis becomes eroded producing a point of entrance for the spirochetes.

3 It is possible but highly improbable that infection may take place by the passage of sounds into the urethra. Cases of this type have been reported but in this day of asepsis and antiseptics such an accident is almost beyond belief

Symptoms —The three principal symptoms are

- 1 Pain
- 2 Discharge
- 3 Induration

1 *Pain* —This is slight, always accompanies micturition, and occurs in the majority of cases toward the end of urination, this is due to the expansion and contraction of the base of the lesion

2 *Discharge* —This is the first symptom noticed by the patient and causes him to consult a physician. In every case a discharge is the initial symptom. It begins slowly after variable periods of incubation, in the beginning it is seldom accompanied by pain at the time of micturition, it is very watery at first, later slightly seropurulent, easily becoming blood-tinged, especially if the urethra is palpated roughly. At times the discharge is thick and purulent, but this is always a sign of mixed infection.

3 *Induration* —This is perceptible only by palpating the glans from behind and in front, the chancre is situated in the substance of the urethra, following an anterior-posterior direction, and, as a consequence, is lamellate in form. Often in the fossa navicularis the induration manifests itself as a cartilaginous mass of variable dimensions.

In women the endo-urethral chancre is situated in the anterior part of the canal. In order to locate the induration, the index finger of the left hand is introduced into the vagina in contact with the suburethral region, while the right index finger examines the meatus from before backward. Sometimes this forms a veritable indurated cylinder, a peri-urethral muff, around the canal. At other times it is limited to the inferior segment of the canal and to the lateral surfaces.

Syphilitic chancre of the urethra is accompanied by indolent inguinal adenitis, the same as any other chancre situated on the penis, at times the dorsal lymphatic vessels appear as an indurated cord.

Diagnosis —Chancre of the meatus should not be difficult of diagnosis from the character of the induration, appearance, and, lastly and most important, from the microscopic examination of the secretion for *Spirochaeta pallida*.

In endo-urethral chancre, most patients present themselves on account of a discharge, this should be immediately examined for gonococci, as this is the most frequent condition that produces a "urethral running." Failure to find any organism either of a specific or non-specific variety should arouse suspicion.

Chancre of the meatus may be confounded with simple chancroid of the meatus, on account of induration caused by the irritating effect of the urine, however, in chancroid there is more discharge and extreme pain, and the lesion may be covered by a membrane with a dirty, moth-eaten appearance.

Superficial erosions due to gonorrhea may simulate chancre of the meatus, or both may exist together.

Herpetic eruptions are multiple, the borders are polycyclic, and, if recent (vesicle stage), clear serum can be expressed from the lesion.

Syphilitic chancre of the meatus may be confounded with epithelioma of the glans here an error in diagnosis might lead to unnecessary operation. The epithelioma may be accompanied by infiltration and adenopathy the same as a chancre.

In women the error may be still more easily made as the periphery of the meatus is the place of election of urethral epithelioma cancerous induration is more extended but less hard and less resistant than the syphilitic induration. The adenopathy is less tardy in the neoplasm and the neoplasm does not tend toward cicatrization.

However in all cases a careful history should be noted together with a complete physical and careful microscopic examination. In examining for *Spirochæta pallida* there is no better way of obtaining the material than by capillary attraction as illustrated on page 192 under Genital Ulcers.

Complications.—The evolution of urethral chancre is slower than that of other syphilitic chancres this is owing in a measure to the constant passage of urine and secondary infection with poor drainage.

Ulceration—Often in the male and female syphilitic chancres of the meatus may form extensive ulcerations the edges become uneven the base grayish and a pseudomembrane may form giving the condition as a whole a formidable appearance.

Phagedæna—Occasionally in practice more especially in dispensary work chancre of the meatus is seen complicated by phagedæna. This condition occurring in endo-urethral lesions is not so common. When occurring at the meatus it may form extensive cavities extending deeply it may even decapitate the glans penis or enlarge the meatus considerably. Extensive mutilation may later cause complete closure of the orifice calling for surgical interference.

Stricture—Chancre of the meatus or endo-urethral chancre may at times cause stricture. Two varieties may occur.

- 1 A diminution of the caliber due to the syphilomatous neoplasm.
- 2 True cicatricial stenosis.

The first variety occurs at the time of the specific induration and is of little importance the stenosis disappears with the reabsorption of the induration.

The second variety follows ulcerated or phagedænic chancres especially of the meatus and fossa navicularis. These strictures in accordance with the general law of cicatricial strictures develop with great rapidity and offer great resistance to dilatation.

Secondary Syphilis.—**Urethral Mucous Syphilides.**—Numerous French authors recognize the possible existence of a specific secondary urethritis. It is characterized by a more or less viscous transparent slightly opalescent discharge rarely creamy or purulent. This is scarcely perceptible during the day but is always present in the morning after the urine has been held all night. Inflammatory symptoms are absent. Microscopic examination without the dark field condenser shows nothing characteristic mucous and epithelial cells predominate. However the *Spirochæta pallida* may be found if the

Symptoms — The three principal symptoms are:

1. Pain
2. Discharge
3. Induration

1. *Pain* — This is slight, always accompanies micturition, and occurs in the majority of cases toward the end of urination; this is due to the expansion and contraction of the base of the lesion

2 *Discharge*.—This is the first symptom noticed by the patient and causes him to consult a physician. In every case a discharge is the initial symptom. It begins slowly after variable periods of incubation: in the beginning it is seldom accompanied by pain at the time of micturition; it is very watery at first, later slightly seropurulent, easily becoming blood-tinged, especially if the urethra is palpated roughly. At times the discharge is thick and purulent, but this is always a sign of mixed infection.

3. *Induration* — This is perceptible only by palpating the glans from behind and in front; the chancre is situated in the substance of the urethra following an anterior-posterior direction, and, as a consequence is lamellate in form. Often in the fossa navicularis the induration manifests itself as a cartilaginous mass of variable dimensions

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In endo-urethral chancre, most patients present themselves on account of a discharge: this should be immediately examined for gonococci, as this is the most frequent condition that produces a "urethral running." Failure to find any organism either of a specific or non-specific variety should arouse suspicion.

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Superficial erosions due to gonorrhea may simulate chancre of the meatus, or both may exist together

Herpetic eruptions are multiple, the borders are polycyclic and if recent (vesicle stage) clear serum can be expressed from the lesion

proper apparatus is used Antisyphilitic treatment rapidly clears up the condition

It is this secondary specific urethritis that is the means of contagion through the semen, which, during this period, in its passage through the urethra at the time of ejaculation, becomes saturated with the urethral discharge and the spirochetes that it contains, thus acting as a carrier of the infection

An interesting case of Rochon is cited by Tanton,⁵ the details of which are as follows A woman presented on the abdomen excoriations caused by her corset, the syphilitic husband, afraid of having syphilitic children, had the habit of ejaculating on the abdomen A gigantic chancre developed at the site of the excoriations The author concluded that urethral mucous syphilides existed

Pini²⁰ reported a case of secondary papulous intra-urethral syphilis in 1931

Tertiary Syphilis.—In 1901, Fournier⁸ reported 19 cases of tertiary syphilis of the urethra, Mauriac,²¹ Gaucher,²² Renault,²³ and Rougier⁴ have observed and reported cases, in 1913 Dey and Kirby-Smith,²⁴ in this country, reported 2 interesting cases More recently, cases have been reported by Valverde,²⁵ Bernhart,²⁶ and Gibson and Wiley²⁷

Time of Appearance —Often they are late, making their appearance eight, ten, or even fifteen to twenty years after the primary symptoms

Modes of Invasion —1 *Primary* —These lesions make their appearance by way of the canal

2 *Secondary* —These lesions appear in the canal from an extension by continuity

In the case of primary localization these lesions may appear under two forms

(a) Primary ulceration

(b) Syphilitic gumma

The latter is the most common form and may be presented under two clinical aspects

1 Circumscribed infiltration

2 Diffuse infiltration

Circumscribed infiltration appears as a small gummatous tumor, often resembling a small tumor or core, forming a slightly rounded or hemispherical projecture

In the diffuse infiltration the gumma grows on the surface, infiltrating the tissues to a variable extent, often appearing as a sheet-like induration

Both of these forms may contract the canal, causing symptoms of obstruction in the greater or less degree However, these forms often undergo softening and ulceration, thereby eliminating, for the time being, obstructive symptoms Hemorrhage following such a condition may be severe

These gummata may break down and ulcerate in either one of two ways toward the urethral canal or on the undersurface If the gumma breaks down on the surface which is in connection with the

urethral canal it often forms internal bial fistula which act as reservoirs and collect urine during the act of micturition. Later these foci may be the starting points of urinary infiltration and abscess.

Symptoms.—Tertiary syphilitic lesions of the urethra have the following characteristics

1. Indolent invasion indolent often remaining for a long time unnoticed
2. Slow evolution It is necessary for these lesions to attain comparatively large proportions before the patient seeks surgical advice.
3. The local reaction is generally insignificant or absent There is no inguinal adenopathy

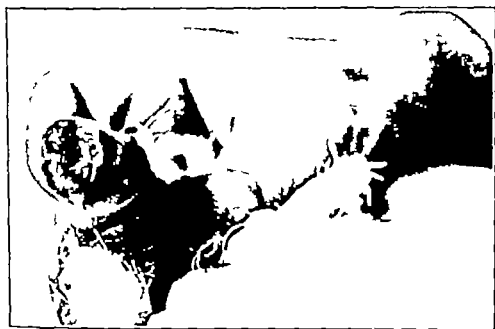


FIG. 66.—Extensive gummatus destruction of the glans penis involving the urethra. Date of primary infection three years previously Wassermann reaction positive. Neglected treatment. One arsenphenamine injection given in May 1911 (author's case)

In general these lesions do not pass the balanitic region for which they seem to have a specially marked predilection

Cylindroid Syphiloma of the Urethra.—Cylindroid syphiloma is a gummatous infiltration which is regular and cylindric. It occurs in a segment of the canal and may lead to stricture. It occurs under two forms

- (a) Sclerotic
- (b) Sclerogummatous.

The sclerotic form is rare severe and resistant to treatment

The sclerogummatous form is benign and yields rapidly to specific treatment the gummata disappear the islands alone persisting. This condition may exist at the same time as other gummatous lesions of the canal from which it seems only a prolongation

proper apparatus is used Antisyphilitic treatment rapidly clears up the condition

It is this secondary specific urethritis that is the means of contagion through the semen, which, during this period, in its passage through the urethra at the time of ejaculation, becomes saturated with the urethral discharge and the spirochetes that it contains, thus acting as a carrier of the infection

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These gummata may break down and ulcerate in either one of two ways toward the urethral canal or on the undersurface If the gumma breaks down on the surface which is in connection with the

gummata or following phagedenic ulceration or as a sequel to cylindrical syphiloma.

The site of the obstruction depends on the form of syphiloma from which it is derived. It is most frequently found at the meatus or in the balanitic region.

The diagnosis of this form of stricture must be made on the particular history of the patient. Diagnosis may be considered under the following headings: Wassermann reaction, microscopic examination of the discharge, and a careful physical examination.

The Wassermann reaction here, as in other forms of tertiary syphilis, if performed by a careful serologist, should be positive in 100 per cent of cases. The urethral discharge is very characteristic. The diagnosis is made by exclusion. If one cannot find any predominating organism, one should be suspicious and a careful search continued until the diagnosis is positive.

Frosive and gangrenous balanitis may produce destructive symptoms at times greatly simulating a broken-down gumma; however, microscopic examination will rapidly settle the question.

Epithelioma, while comparatively rare, must be thought of. Glandular enlargement, however, occurs early. Gummata here, as elsewhere, grow very slowly and ulcerate only after some time. They are only slightly painful and, as a rule, are attended by no constitutional symptoms; however, both gumma and neoplasm have the common characteristic of being indurated. The cancerous discharge is purulent, foul-smelling, often streaked with blood, and the pain at micturition is severe. If the urethra is explored with a sound or bougie, there is abundant bleeding. Often the sound will bring away particles of the tumor. These should be microscopically examined immediately. Neoplastic induration often adheres to the deeper parts, ulcerates the skin, and produces a fistula surrounded by neoplastic offshoots.

In the neoplasm the edges of the ulceration are projective, thick, and resistant; the surface bleeds easily, with a characteristic fetid discharge.

In syphilitic gumma there is no adherence to subjacent parts; the base is unequal, and if seen early, there often exists a yellowish adherent scab with central necrosis. The base is indurated but not painful; secretion is not marked. The Wassermann reaction is always negative in epithelioma, and a biopsy will rapidly clear up the diagnosis.

Occasionally urinary abscess may be mistaken for gumma. Here the history, either of traumatism or of previous stricture, should be sufficient to make the picture plain.

Prognosis.—The prognosis of primary lesions, whether occurring at the meatus or endo-urethrally, depends on a prompt diagnosis. If treatment is begun early, before there is any secondary infection and destruction, these lesions cause no further symptoms.

However, in tertiary syphiloma the prognosis varies according to the character of the lesion. In simple uncomplicated cases ulcerations scar over rapidly, and gummata dissolve. But if there is great destruction of tissue with resulting strictures, treatment may be prolonged and unsatisfactory.

Complications following Tertiary Urethral Syphilis — Phagedena — Phagedenism, according to Fournier, is the most serious and gravest complication that can occur. He says that one should be impressed with the fact that genital phagedenism occurs as a complication in tertiary syphilitic lesions more frequently than in simple chancres. Here phagedena of the urethra may not only destroy the meatus, but also may extend extensively into the glans portion of the urethra. This is particularly noticeable inferiorly, where gummata are most often encountered. From this extensive destruction hypospadias of the glans portion may occur to a greater or less degree.

Fistula —As a result of this extensive destruction, fistulæ are very frequent. They may be in the following locations: fistulæ of the



FIG. 67 —Beginning gumma of the glans penis involving the urethra. No previous treatment. Wassermann reaction positive. (Author's case.)

balanopreputial groove, of the fossa navicularis, or of the body of the penis, causing destruction of the penile portion of the urethra to a greater or less extent.

Albarran²⁸ says: "It is probable that certain fistulæ are veritable urinary abscesses with secondary infection, the microorganisms gaining entrance into the lesions through the canal, thus acting as a great open portal for entrance into peri-urethral tissue."

Stricture —Strictures may be of two kinds, false, or pseudostrictures, and true strictures.

False strictures occur during the formation of the gumma and, once they ulcerate or dissolve, empty their contents either into the urethra or externally, and the stricture disappears.

True or cicatricial strictures occur secondary to ulcerated urethral

difficult to make a differential diagnosis of syphilis of the prostate from infections that occur in the prostate and hypertrophy of the prostate as there is nothing pathognomonic either by cystoscopy or rectal examination that will aid us in diagnosing this condition. It is only in the presence of a positive Wassermann reaction and the subsidence of symptoms under specific treatment that we can venture to make a diagnosis of syphilis of the prostate. Where it is possible to obtain pathological tissue for a biopsy the diagnosis will be more accurate.

SYPHILIS OF THE BLADDER.

By syphilis of the bladder is meant only those diseases which involve the bladder mucous membrane itself. All those affections which extend from the surrounding tissues to the bladder whether they come from syphilis of the rectum in man or syphilis of the uterus and vagina in woman are not considered.

Syphilitic lesions of the bladder were scarcely known until the first edition of Cabot's *Urology* was published in 1916. Most of the earlier works on syphilology and urology failed to make mention of the subject. More recently, however, observations have been published and numerous articles have appeared both in our own and in the foreign literature describing the clinical picture in detail.

The history of this affection is divided into three distinct periods.

In the first period there was almost complete obscurity. There was cited only an occasional observation of autopsy findings in syphilitics who had died on account of their urinary lesions, ulcers, perforations and tumors which were discovered on opening the bladders. This extended down to the year 1872 at which time Tarnowsky⁴² reported a case in a child aged four years infected by its foster mother.

In the second period are related some clinical observations, the diagnosis being based solely on the result of treatment, some of these observations lack accuracy. However a sign of advance in the understanding of this condition was the fact that the cases published during the second period were all diagnosed in life and many of the patients recovered under specific treatment.

In the third period the diagnosis was made by the cystoscope with the addition many times of the Wassermann reaction.

FIRST PERIOD FROM 1767 TO 1872

During this period 9 cases of syphilis of the urinary bladder were reported, all diagnoses were made at the autopsy table. Of these 9 cases 5 were undoubtedly gummata and 4 were secondary lesions. Following is a chronological list of the cases reported during this first period: Morgagni⁴³ 1767, Follin⁴⁴ 1840, Ricord⁴⁵ 1851, 2 cases, Virchow⁴⁶ 1852, Vidal⁴⁷ 1853, Tarnowsky⁴² 1872, Fenwick⁴⁸ 1898 and Neumann⁴⁹ 1899. Although the reports published by Fenwick and Neumann appeared at a late date, the cases really belong to the first period 1767 to 1872.

Treatment.—In chancre of the meatus and endo-urethral chancre the treatment is the same as described under primary lesions elsewhere (See Chapter under Genital Ulcers)

In tertiary lesions of the urethra the treatment is the same as that described under Tertiary Lesions of the Bladder

For the treatment of stricture following tertiary lesions of the meatus and urethra the reader is referred to the chapter on Strictures

SYPHILIS OF THE PROSTATE

The small number of reports in the literature up to the present time would seem to indicate that syphilis of the prostate is extremely rare. Unlike the bladder, infections in the prostate only manifest themselves in the destructive lesions of tertiary syphilis.

When we stop to consider that syphilitic infection can occur in any part of the human organism, it is only natural to suppose that now and again it would involve the prostate. Consequently, if we hope to recognize this condition in the future, it will be necessary to make a careful examination for prostatic involvement in all cases that are at all atypical.

In 1920 Thompson³⁹ reviewed the literature on syphilis of the prostate. His article dates from 1836 to 1920, inclusive, and contains reports from the following authors: Rattier,³⁰ 1836, Ricord,³¹ 1851, Reliquet,³² 1885, Wroczynski,³³ 1894, Groszlik,³⁴ 1897, Rochon,³⁵ 1897, Drobny,³⁶ 1906, Kudinsteff,³⁷ 1908, 2 cases, Power,³⁸ 1908, Divaris,³⁹ 1908, Desnos,⁴⁰ 1910, 2 cases, Jungano,⁴¹ 1910, Cook,⁴² 1912, Rush,⁴³ 1913, Wright,⁴⁴ 1914, Ulrich,⁴⁵ 1915, Ravogli,⁴⁶ 1916, 2 cases, Portillo,⁴⁷ 1917, Warthin,⁴⁸ 1918, Thompson,⁴⁹ 1916.

Still more recently a report of Comolli⁵⁰ shows that syphilis of the prostate is of sufficient importance to warrant a detailed review of the literature during the last ten years. Comolli found that 44 cases of prostatic syphilis have been reported in the literature, mostly in French and Italian journals. Of these cases, he believes that only 30 were authentic. Cohn's⁵¹ report, in 1926, was based on 22 cases. Comolli says that prostatic syphilis may run for a long time without symptoms. Tertiary manifestations may be met in from six to thirty-nine years after contagion. Cases of recent contagion are very rare. The prostate was reported as increased in size in 25 cases, the right lobe in 10, the left lobe in 5, the middle lobe in 3 (when mentioned). The consistency of the gland varied from hard elastic to cartilaginous. The glandular acini were usually not hyperplastic but rather smaller and fewer. If untreated, the syphilitic infiltration evolves, spreading to surrounding regions, death is due to marasmus. In addition to the 24 cases reported by Lloyd Thompson, Comolli cites as authentic the following reports of cases: Shess,⁵² 1920, 2 cases, Fernandez,⁵³ 1922, Nogues,⁵⁴ 1922, Starry,⁵⁵ 1924, Bruna,⁵⁶ 1924, Salleras,⁵⁷ 1925, Cohn,⁵¹ 1926, Pini,⁵⁸ 1927, Luque,⁵⁹ 1929, Castano,⁶⁰ 1929, Riba,⁶¹ 1929.

A study of the symptoms in these cases shows that it is extremely

1920 Thompson,¹ 1920 Cifuentes² 1921, Chocholka¹¹ 1921 Castano and Castano¹⁰¹ 1921, DeGouvea,¹⁰² 1921, Peterson¹⁰³ 1921 Sachhof¹⁰⁴ 1925 Blanc and Negro¹⁰⁵ 1925 Avramovici¹⁰⁶ 1926, Riley¹⁰⁷ 1926 Schwarz¹⁰⁸ 1926 Rothschild¹⁰⁹ 1926 Molina¹¹⁰ 1927, Turner¹¹¹ 1927 Pugh¹¹² 1927 Gautier¹¹³ 1927 Ries¹¹⁴ 1928 Chocholka¹¹⁵ 1928 Nikiten¹¹⁶ 1928 Isnardi¹¹⁷ 1929, Valverde¹¹⁸ 1929 Mertz and Miller¹¹⁹ 1929, Raurich¹²⁰ 1930 Colodrero and Di Lella¹²¹ 1930 Orofino¹²² 1930 Arrues¹²³ 1930 Valverde¹²⁴ 1930 Ajami¹²⁵ 1931, Chocholka¹²⁶ 1931 Valverde¹²⁷ 1931-1932 von der Becke,¹²⁸ 1932 Chocholka¹²⁹ 1932 Levy and Tripoli¹³⁰ 1933 and Ichikawa and Shinoda¹³¹ 1934

Pathology—The pathology of vesical syphilitic lesions is the same as that found in syphiloma in other parts of the body.

Symptoms.—SECONDARY SYPHILIS.—*Ige*—It generally occurs in early adult life.

During the period of secondary eruption, if the infection is severe there frequently occurs a diffuse syphilitic cystitis.

If one stops to consider that during the period of secondary invasion the spirochetes localize in every organ of the body it is not surprising that at times there should be vesical lesions during this period, however in the majority of cases they are overshadowed by the general infection and rapidly lose their identity once specific treatment is instituted.

In the more severe cases of infection there are all the symptoms of acute and chronic inflammation of the bladder i. e. pyuria pollakuria pain and tenesmus. It must not be forgotten that secondary lesions no matter where located are not destructive and as a consequence the accompanying symptomatology may be insignificant compared with that of gumma.

During this period secondary symptoms such as mucous plaques, condylomata and secondary skin eruptions are common.

Cystoscopic Examination—During this period the vesical mucosa often shows an increased vascularization or more or less congestion. Scattered diffusely over the mucosa are little islands of mucus. In the more severe forms the exact duplicate of the mucous patch may occur this may be multiple and become so extensive as to form distinct ulcers. There is also a form of vegetating syphiloderm which throughout the literature has been described as gumma of the bladder except by Denslow. In our case¹³ the diagnosis of condyloma was made independent of Denslow's report which we did not see until later.

It may easily be conceived that the changes which occur in a papule on the skin on a moist surface may occur on the moist mucous surface of the bladder. This may occur at any time after the primary invasion. According to Thompson this moist papular syphiloderm may occur thirty years after a primary lesion when no treatment has been given.

The bladder offers a warm moist bed for the growth and development of the spirochetes. Its thin mucous membrane may be regarded

SECOND PERIOD, FROM 1872 TO 1900

During the second period, 1872 to 1900, cases of syphilis of the bladder were reported by Morris,⁷⁰ 1897, Griwzow,⁷¹ 1899, 2 cases, Chezelitzer,⁷² 1901, Margouliès,⁷³ 1902, and Towbien,⁷⁴ 1904

THIRD PERIOD, FROM 1900 TO 1935

The rapid progress made, coincident with the development of the cystoscope, in the diagnosis of vesical lesions, is particularly noticeable during this period, while the first authentic reports of Matzenauer⁷⁵ appeared in 1900, others were still using the older therapeutic diagnostic test and reporting their cases (Chezelitzer, Margouliès and Towbien)

It is interesting to note how, in the first years of the second period (1872 to 1900), the syphilitic nature of the bladder infection was only occasionally discovered, how later physicians came to consider the possibility of bladder syphilis more and more, and how, at last, Matzenauer, in 1900, opened the modern period by publishing the first report of a case of syphilitic ulcerations of the bladder, as observed by means of the cystoscope. Since then the serum reaction of Wassermann has been added as strong supporting evidence in diagnosis.

Since the appearance of the second edition of this book, in 1924, numerous articles have been written on syphilis of the bladder. In this country the reports have been scanty. This is due, I believe, to the better social conditions and also to the educational activities of the American Public Health Service. There is no question but that syphilis has been decreasing here since the World War. In the Latin republics, however, the literature is full of reports of cases, showing that syphilis is still a common disease there. No doubt because of social conditions the disease is often neglected and, therefore, appears in many bizarre forms within the viscera. There seems to be a tendency in many of the reports to minimize the importance of the cystoscopic picture, most observers seemingly being content to confirm the diagnosis by means of the Wassermann test and the results of specific treatment. Although the typical symptoms of secondary and tertiary syphilis of the bladder have been well described, Chocholka⁷⁶ believes that in the majority of cases the cystoscope is of little value in making a diagnosis because the morphology of syphilis of the bladder is not sufficiently characteristic. He says that the important point is to exclude all other causes when syphilis is suspected.

Following is a chronological list of articles that have been published by various authors on secondary and tertiary syphilis of the bladder: Matzenauer,⁷⁵ 1900, MacGowan,⁷⁷ 1901, Le Fur,⁷⁸ 1902, Graft,⁷⁹ 1906, von Engelmann,⁸⁰ 1911, Asch,⁸¹ 1911, Pereschwkin,⁸² 1911, Michailoff,⁸³ 1912, Mucharinsky,⁸⁴ 1912, Picot,⁸⁵ 1912, Picker,⁸⁶ 1913, Gayet and Favre,⁸⁷ 1914, Schapira,⁸⁸ 1915, Pedersen,⁸⁹ 1916, Nilson,⁹⁰ 1916, Gouvea,⁹¹ 1916, Baker,⁹² 1917, Fowler,⁹³ 1917, Denslow,⁹⁴ 1918, Wallace,⁹⁵ 1918, Cole,⁹⁶ 1918, Hesse,⁹⁷ 1918, Danforth and Corbus,⁹⁸

may be scant or profuse repeating at irregular intervals often acting in a peculiar manner capricious at times as in hemorrhages due to neoplasms.

1. Pollakiuria is a frequent symptom the urine almost always contains a large quantity of red cells and leukocytes rarely have any organisms been found.

As a rule the general physical condition is little affected.

Cystoscopic Examination—Tertiary syphilis manifests itself on the vesical mucous coat in the form of ulcerations.

The diagnosis of ulcerations is not difficult they may be rounded more or less extended isolated or multiple they make projections into the vesical cavity the edges are infiltrated and the base is generally covered with a yellow purulent mass.

It must not be forgotten that syphilis of the bladder may have its course quite independent of other syphilitic manifestations. The most varied forms will be observed from simple hyperemia of the mucous membrane to extended breaking down of gummatous tissue.

Diagnosis.—*Secondary and Tertiary Syphilis*—Syphilis may affect the bladder as well as any other part of the body but there is no such thing as chancre of the bladder. Syphilitic affections of the bladder that produce several destructive symptoms belong to the tertiary period.

Syphilitic ulceration of the bladder mucous membrane may be solitary or it may appear at the same time as syphilis of the skin and other mucous membranes.

During the secondary stage of the disease on the mucous membrane of the bladder may be found a general or localized eruption which may be in the form of ulcerous processes resembling mucous patches.

Gumma of the bladder simulates the ulcerative form of papillary carcinoma. This is especially manifest when they are both broken down and covered with mucus. As these tumors may occur during the later periods of life the time when malignancy generally occurs a differential diagnosis is important. One should consider the age of the patient the history and the possibility of specific infection.

These ulcers may extend deep and lead to perforation of the bladder peritoneum or to vesico-vaginal fistula.

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Simple solitary ulcers should arouse suspicion of syphilis especially if tuberculosis can be excluded by bacteriological examination. Syphilitic ulcers can be distinguished from ordinary or tuberculous ulcers by the infiltrated edges which project more or less into the ulcer cavity.

Vegetating syphiloma generally causes symptoms of new growth and hemorrhages which are not influenced by rest or other treatment. Hemorrhages from gumma may last from the beginning to the end of urination while hemorrhages in ulcers of the bladder even if syphilitic are terminal.

Ulcers are more apt to cause pyuria than gummata.

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As studied with the cystoscope, these tumors simulate a papilloma so closely that it is impossible at times to differentiate between them. In many of the cases reported, these growths are referred to as gummata, as few observers believed them to be identical with condylomata which occur upon the skin.

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The histopathology of the vegetating syphiloderm has been described by Dennie as follows:

When sectioned, the lesion is seen to consist of two parts, an upper, dense, finely striated portion, about 4 mm. thick, and a lower narrowed core. Microscopically the former shows many slender epithelial fingers connected above by thin bridges and below penetrating the corium.

TERTIARY SYPHILIS — *Age* — Gumma of the bladder occurs especially in middle life, thirty-five to fifty years of age, but may occur earlier or later.

- 1 Pains are variable, intermittent or continued, or radiating at times, increased on deep pressure, little marked if the lesions lie on the base of the bladder, much more marked at the time of micturition if they lie at the vesical neck.

- 2 Hematuria is the most constant and important symptom. There may be a terminal hematuria, intermittent hematuria, or a constant hematuria, lasting from the beginning to the end of urination. This

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The number, size, and location of the lesions greatly influence the accompanying symptomatology

In concluding a diagnosis of any ulcerating lesion of the bladder of doubtful origin, the solitary ulcer of Fenwick and the elusive ulcer of Hunner must be considered

Treatment —It must not be forgotten that vesical syphilis, whether secondary or tertiary, is only an incident in the course of a general syphilitic infection and that after the vesical lesions are healed, every effort known to modern medicine should be made to safeguard the patient from a relapse in other organs

The Wassermann reaction offers the best and most efficient guide in the management of syphilitic cases. Unfortunately, the tendency is to give too little treatment and to stop when the first negative reaction is obtained

Under the new therapy (arsphenamine, mercury, and bismuth) all patients who come under observation should be treated at least nine months after the negative goal is reached, giving during this period continuous mercury rubbings and injections of bismuth, supplemented by at least two courses of intravenous injections of arsphenamine. It must be distinctly understood that treatment should be continued vigorously during the "negative phase," in order to secure permanent results. It should be borne in mind that dilatory and haphazard treatment, while healing the lesions, often produces both an arsphenamine- and mercury-fast spirochete which, when localized in other regions (spinal fluid), may never be dislodged

Spinal fluid examinations, while appearing superfluous, are much indicated here as in other forms of visceral syphilis, and a physician with the patient's best interests at heart should certainly insist on making them

Spinal Cord Affections Simulating Bladder Disease —Besides these secondary and tertiary syphilitic diseases of the bladder there are a considerable number of cases that come under observation on account of spinal cord disease (progressive paralysis and tabes)

THE TABETIC BLADDER FROM THE STANDPOINT OF THE UROLOGIST

The primary consideration in this class of cases is the earliest possible recognition of any urinary changes which may occur in syphilitic involvement of the nervous system prior to the development of obvious tabetic or ataxic symptoms. The major problem, however, involves an accurate diagnosis in those cases in which the specific tabetic process has become apparently dormant, while the urinary abnormality persists or gradually increases in severity

The secondary pathological changes in the urinary tract depend on the extent and character of nerve destruction involved in the paralytic process. A thorough study of the innervation of the apparatus for urine expulsion has been made by de Lisi and Colombino¹³¹. According to these authors, the bladder receives a triple system of nerves

The most important group proceeding from the sympathetic system by way of the second, third and fourth lateral lumbar ganglia, the mesenteric ganglia, the hypogastric nerves and the hypogastric plexus; secondly, by way of the pelvic nerves of the autonomous sacral group. The third system of nerves provides for the external sphincter of the urethra and the perineal muscles which are auxiliary to the expulsion of urine. The latter are represented by the pudendal and belong to the sacral plexus and therefore to the cerebrospinal system. This system is not usually affected except in the most advanced stages of the disease.

From a study of the innervation it is seen that any attempt to correlate the neuropathology of bladder disturbances is extremely difficult. Repeated usage of the terms preclinical or preataxic and clinical or "ataxic" has classified the disease into these two stages. It is the former which most concerns the urologist as a diagnostic problem since the alterations of bladder function are most difficult of interpretation in the earliest stages of nerve-fiber involvement.

A recent study of the very earliest changes which might occur in persons with active cerebrospinal syphilis but without definite tabetic symptoms is given as follows:

TABLE 1.—EARLY URINARY CHANGES IN PATIENTS WITH ACTIVE CEREbroSPINAL SYPHILIS, BUT WITHOUT TABETIC SYMPTOM

Condition	Number of cases	Latent, assumed
Positive blood Wassermann reaction	78	50
Positive spinal fluid Wassermann reaction	50	50
Hyperactive patellar reflex	8	50
Latellar reflex absent	0	50
Romberg sign	0	50
Argyll Robertson pupil	5	15
Babinski sign	0	34
Frequency of urination	7	50
Difficulty in starting stream	1	50
Occasional dysuria	3	50
Nocturnal incontinence of urine	2	50
Residual urine	14	50
Relaxed rectal sphincter	3	50

Of the 8 patients with hyperactive knee-jerks, 4 complained of some frequency of urination and 3 of occasional dysuria. None of these patients had any residual urine when tested by catheter. No pathological condition of the urinary tract was demonstrable apart from bladder irritability. The urinalysis was normal in all.

Of the 14 patients with residual urine, 3 had relaxed rectal sphincters, 2 had nocturnal incontinence and 4 had Argyll Robertson pupils. The smallest amount of residual urine was 60 cc. and the largest 180 cc. This was tested on two or more occasions. Pyuria was present in 4 of these cases. In none of these patients was there sufficient urinary distress to cause them to seek medical advice except in the 2 cases of nocturnal incontinence. All were under active syphilitic management. In the preataxic stage, there may be definite bladder symptoms such as frequency and dysuria, with or without urine retention.

STANDARD SYPHILIS TECHNIQUE NUMBER 2.

Case No

LATE PRIMARY SYPHILIS) Spirochaeta Positive
/ Blood Wassermann Positive

Name

BLOOD WASSERMANN Date

Finding

When giving reaction state whether none - mild - moderate - or severe Regulate Arspenamine dose to weight of patient 1 decigram for each 20 lbs of body weight

ARSPHENAMINE ONCE WEEKLY FOR 6 WEEKS

1ST WEEK		2ND WEEK		3RD WEEK		4TH WEEK		5TH WEEK		6TH WEEK	
Date	Dose	Date	Dose	Date	Dose	Date	Dose	Date	Dose	Date	Dose
Reaction		Reaction		Reaction		Reaction		Reaction		Reaction	

ARSPHENAMINE ONCE WEEKLY FOR 4 WEEKS

7TH WEEK		8TH WEEK		9TH WEEK		10TH WEEK		11TH WEEK		12TH WEEK		13TH WEEK		14TH WEEK	
Date		Date		Date		Date		Date		Date		Date		Date	
Reaction		Reaction		Reaction		Reaction		Reaction		Reaction		Reaction		Reaction	

FOUR WEEKS OF MERCURY RUBBINGS OR OF BISMUTH INJECTIONS OR OF A SOLUBLE MERCURY SALT

15TH WEEK		16TH WEEK		17TH WEEK		18TH WEEK	
Date		Date		Date		Date	
Reaction		Reaction		Reaction		Reaction	

ARSPHENAMINE ONCE WEEKLY FOR 3 WEEKS

19TH WEEK		20TH WEEK		21ST WEEK	
Date		Date		Date	
Reaction		Reaction		Reaction	

FOUR WEEKS OF MERCURY RUBBINGS OR OF BISMUTH INJECTIONS OR OF A SOLUBLE MERCURY SALT

22ND WEEK		23RD WEEK		24TH WEEK		25TH WEEK	
Date		Date		Date		Date	
Reaction		Reaction		Reaction		Reaction	

ARSPHENAMINE ONCE WEEKLY FOR 2 WEEKS

26TH WEEK		27TH WEEK	
Date		Date	
Reaction		Reaction	

FOUR WEEKS OF MERCURY RUBBINGS OR OF BISMUTH INJECTIONS OR OF A SOLUBLE MERCURY SALT

28TH WEEK		29TH WEEK		30TH WEEK		31ST WEEK	
Date		Date		Date		Date	
Reaction		Reaction		Reaction		Reaction	

ONE INJECTION OF ARSPHENAMINE

32ND WEEK	
Date	
Reaction	

BLOOD WASSERMANN Date

Finding

Finding

SPINAL FLUID WASSERMANN Date

If Blood Wassermann is positive treat as latent syphilis (card 5) If Spinal Fluid Wassermann is positive treat as Neuro-syphilis (card 7) If Blood Wassermann is Negative and Spinal Fluid is Negative apply discharge technique DISCHARGE TECHNIQUE Ne active Blood Wassermann ever four mo this for one year after treatment has stopped

This system was developed by Dr B C Corbush, Chicago

Published by PAINCIGANS' RECORD Co., Chicago

Illinois Social Hygiene League, Chicago

STANDARD SYPHILIS TECHNIQUE NUMBER 0—PAGE 1

Case No

Name

TERTIARY
SYPHILIS
(Blood Wassermann, Venereal Syphilis, Wassermann, and other tests)

BLOOD WASSERMANN Date

Finding

SPINAL FLUID WASSERMANN Date

Finding

If Spinal Fluid is positive case should be treated as Neurosyphilis. When giving reaction state whether—none—moderate—or severe Regular Arphenamine dose to weight of patient, 1 decigram for each 30 lbs. of body weight.

POTASSIUM IODIDE FOR 4 WEEKS—50 GRAINS DAILY—PATIENT SHOULD CALL ONCE WEEKLY FOR OBSERVATION

1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK
Date	Date	Date	Date
Reaction	Reaction	Reaction	Reaction

ARSPHENAMINE INJECTIONS ONCE WEEKLY FOR 8 WEEKS

5TH WEEK	6TH WEEK	7TH WEEK	8TH WEEK	9TH WEEK	10TH WEEK	11TH WEEK	12TH WEEK
Date	Date	Date	Date	Date	Date	Date	Date
Reaction	Reaction	Reaction	Reaction	Reaction	Reaction	Reaction	Reaction

POTASSIUM IODIDE FOR 4 WEEKS—50 GRAINS DAILY—PATIENT SHOULD CALL ONCE WEEKLY FOR OBSERVATION

13TH WEEK	14TH WEEK	15TH WEEK	16TH WEEK
Date	Date	Date	Date
Reaction	Reaction	Reaction	Reaction

ARSPHENAMINE INJECTIONS ONCE WEEKLY FOR 8 WEEKS

17TH WEEK	18TH WEEK	19TH WEEK	20TH WEEK	21ST WEEK	22ND WEEK	23RD WEEK	24TH WEEK
Date	Date	Date	Date	Date	Date	Date	Date
Reaction	Reaction	Reaction	Reaction	Reaction	Reaction	Reaction	Reaction

MERCURY RUBBINGS OR INJECTIONS OF BISNUTH OR OF A SOLUBLE MERCURY SALT FOR 8 WEEKS—HAVE PATIENT RETURN ONCE WEEKLY FOR OBSERVATION

25TH WEEK	26TH WEEK	27TH WEEK	28TH WEEK	29TH WEEK	30TH WEEK	31ST WEEK	32ND WEEK
Date	Date	Date	Date	Date	Date	Date	Date
Reaction	Reaction	Reaction	Reaction	Reaction	Reaction	Reaction	Reaction

BLOOD WASSERMANN Date

Finding

SPINAL FLUID WASSERMANN Date

Finding

If Blood Wassermann is positive repeat above course from beginning. In that case use form on back of this sheet. If Blood Wassermann is negative repeat above course without a mercury rub for the purpose of potassium iodide then, polydisperse the technique. DISCHARGE TECHNIQUE Negative Blood Wassermann every four months for one year after treatment has stopped.

This system was developed by Dr. B. C. Corbitt, Chicago.

Published by PUTNAM & HARRISON Co. (U.S.A.)

Blind Social Hygiene League Chicago

STANDARD SYPHILIS TECHNIQUE NUMBER 6—PAGE 2.

TERTIARY { Skin lesions
 { Bone lesions
SYPHILIS { Mucous membrane
 { Vascular Syphilis
 Blood Wassermann positive
 Spinal Fluid Wassermann negative

BLOOD WASSERMANN Date..... Finding.....

If Spinal Fluid is positive case should be treated as Neuro syphilis (card 7) If Blood Wassermann is positive and Spinal Fluid Wassermann negative follow the treatment here outlined which is the same as for Late Secondary When giving reaction state whether—none—mild—moderate—or severe Regulate Arspenamine dose to weight of patient, 1 decigram for each 30 lbs. of body weight

POTASSIUM IODIDE FOR 4 WEEKS—50 GRAINS DAILY—PATIENT SHOULD CALL ONCE WEEKLY FOR OBSERVATION

1ST WEEK	Date	Dose	2ND WEEK	Date	Dose	3RD WEEK	Date	Dose	4TH WEEK	Date	Dose
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ARSPHENAMINE INJECTIONS ONCE WEEKLY FOR 8 WEEKS

5TH WEEK	Date	Dose	6TH WEEK	Date	Dose	7TH WEEK	Date	Dose	8TH WEEK	Date	Dose	9TH WEEK	Date	Dose	10TH WEEK	Date	Dose	11TH WEEK	Date	Dose	12TH WEEK	Date	Dose
Reaction			Reaction			Reaction			Reaction			Reaction			Reaction			Reaction			Reaction		

POTASSIUM IODIDE FOR 4 WEEKS 50 GRAINS DAILY—PATIENT SHOULD CALL ONCE WEEKLY FOR OBSERVATION

13TH WEEK	Date	Dose	14TH WEEK	Date	Dose	15TH WEEK	Date	Dose	16TH WEEK	Date	Dose
-----------	------	------	-----------	------	------	-----------	------	------	-----------	------	------

ARSPHENAMINE INJECTIONS ONCE WEEKLY FOR 8 WEEKS

17TH WEEK	Date	Dose	18TH WEEK	Date	Dose	19TH WEEK	Date	Dose	20TH WEEK	Date	Dose	21ST WEEK	Date	Dose	22ND WEEK	Date	Dose	23RD WEEK	Date	Dose	24TH WEEK	Date	Dose
Reaction			Reaction			Reaction			Reaction			Reaction			Reaction			Reaction			Reaction		

MERCURY RUBBINGS OR INJECTIONS OF BISMUTH OR OF A SOLUBLE MERCURY SALT FOR 8 WEEKS—HAVE PATIENT RETURN ONCE WEEKLY FOR OBSERVATION

25TH WEEK	Date	26TH WEEK	Date	27TH WEEK	Date	28TH WEEK	Date	29TH WEEK	Date	30TH WEEK	Date	31ST WEEK	Date	32ND WEEK	Date
-----------	------	-----------	------	-----------	------	-----------	------	-----------	------	-----------	------	-----------	------	-----------	------

BLOOD WASSERMANN Date..... Finding.....

SPINAL FLUID WASSERMANN. Date..... Finding.....
If Blood Wassermann is positive repeat above course from beginning If Blood Wassermann is negative repeat above course substituting mercury rubs for the course of potassium iodide then apply discharge technique DISCHARGE TECHNIQUE Negative Blood Wassermann every four months for one year after treatment has stopped

The patellar reflexes may be absent but on the contrary these may be normal or exaggerated. During this period the blood Wassermann reaction may or may not be positive while the spinal fluid Wassermann reaction is invariably positive unless the patient has previously had prolonged antisyphilitic treatment. The presence of an Argyll Robertson pupil or lost knee reflexes together with a relaxed rectal sphincter should always suggest cerebrospinal syphilis. In concluding a diagnosis greater stress should be placed on the spinal fluid analysis than on the cystoscopic picture unless the patient has previously had intensive antisyphilitic treatment.

As a means of comparison of the clinical picture which may be presented in more advanced cases the findings in 20 patients with definite ataxic symptoms is given.

TABLE 2.—FINDINGS IN 20 PATIENTS WITH DEFINITE ATAXIC SYMPTOMS.

Condition	Number of patients
Positive blood Wassermann reaction	12
Positive spinal fluid Wassermann reaction	20
Hyperactive patellar reflex	2
Patellar reflex absent or sluggish	12
Romberg sign	1
Argyll Robertson pupil	10
Frequency of urination	1
Infrequency of urination	0
Difficulty in starting stream	3
Dysuria	4
Incontinence	—
Loss of sexual power	13
Crises (gastric or vesical)	3
Hematuria	1
Uremia	0
Pyuria	7
Prostatitis	1
Relaxed rectal sphincter	6
Residual urine	18

Diagnosis. The accurate diagnosis of tabetic involvement of the urinary bladder requires a definite routine method of procedure. Following the usual careful clinical history and physical examination urinalyses and renal function tests should be made. Because of the existence of residual urine in these cases it is not advisable to perform the standard dye-excretion tests unless routine catheterization of the bladder has previously been in vogue. Estimations of the urea nitrogen content of the blood will give a more accurate and entirely safe means of ascertaining the renal function. Palpation and percussion of the lower urinary tract and estimation of the residual urine under strict asepsis will reveal the local condition.

It must be emphasized again that regardless of the blood Wassermann reaction spinal puncture must be performed and a careful cell count and Wassermann test made with the spinal fluid.

Lastly cystoscopic examination cystograms or other roentgenological tests should be made in the more limited number of cases in which these procedures are indicated.

Cystoscopic Findings —The cystoscopic picture will vary with the extent, duration, and severity of the destruction of innervation to the bladder itself, the bladder sphincter, and the posterior urethra. It will also depend upon the presence or absence of urinary infection and possibly anatomical abnormalities in these regions.

There is a definite relaxation of the internal vesical sphincter and, although the external sphincter may be spastic, the urethra is usually much more tolerant to the examination. This relaxation evidences itself by more or less obliteration of the normal outline of the bladder neck and encroaching prostatic lobes, and distorts the visual picture by a funnel-shaped continuity of the bladder outlet and prostatic

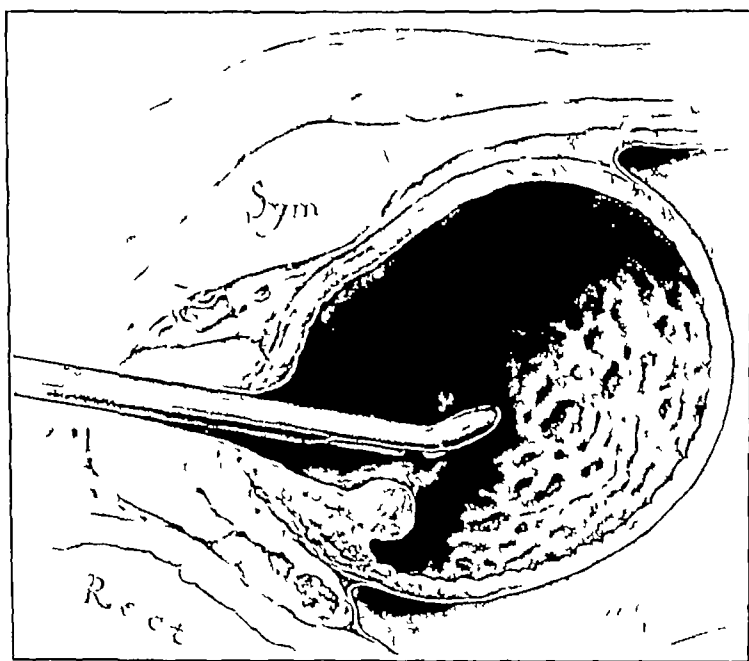


FIG 68 —Cystoscope in faulty position, resulting in diagnosis of median bar obstruction. The hypertrophy of the trigone and interureteric muscle, with complete relaxation of the internal sphincter, obliterates the identity of the outline of the neck of the bladder. The interpretation is especially difficult in the presence of severe bladder infection with ulceration.

urethra terminating at the external vesical sphincter. The entire posterior urethra can thus be as easily examined with the ordinary cystoscope (preferably a posterior sheath lens system) as the bladder itself.

The floor of the bladder, consisting mainly of the trigone, is elevated and the interureteric bar is markedly elevated and often greatly hypertrophied. There is frequently a very deep pocket behind this muscular ridge, bringing about an unusually deep *bas fondé*. Care must be taken in the orientation of this picture, as even a skilled cystoscopist might erroneously consider this a "median bar" obstruction (Fig 68).

At the sides the trigone tapers off into pronounced areas of muscular hypertrophy with relaxation of the bladder wall between. This trabeculation results in the formation of saccules or deeper pockets between the prominent muscle bundles.

It has been stated that the trabeculation has a predilection for the lateral fornices of the bladder. At any event it is undoubtedly more patchy in distribution than the usually more generalized trabeculation following a long-standing obstruction at the vesical outlet.

The ureteral orifices usually show but slight changes although in

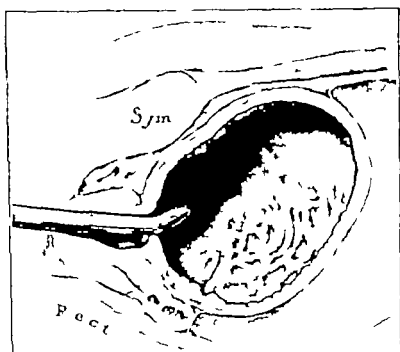


FIG. 69.—Median bar obstruction as the true cause of urinary retention in an active case of tabes.

later stages of the tabetic process they may appear markedly relaxed and gaping with a resultant sluggishness of urine efflux.

It must be carefully borne in mind that even in patients with definite cerebrospinal syphilis or even an apparent tabes the urinary symptoms may be due to a mechanical obstruction. The conditions most often overlooked in these cases are median bar obstruction median lobe prostatic hypertrophy contracture of the vesical neck, due to a sclerotic process in the prostate and hypertrophy of the trigone. (Figs. 69 and 70.)

Prognosis.—The prognosis will depend upon the extent of irreparable nervous destruction by the syphilitic process. The general condition of the patient the extent of cardiovascular involvement the amount of residual urine the presence or absence of urinary infection and the tenacity of both patient and physician to adhere to a long painstaking program of carefully executed specific treatment are the important factors.

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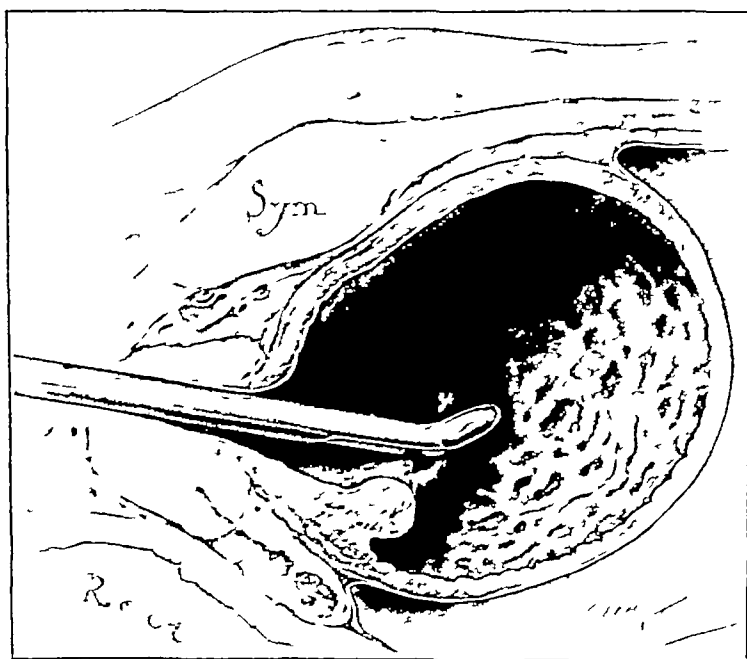


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Local Treatment—Forced fluids during the day and urinary anti-septics are valuable in the earlier cases. It is best to avoid all local manipulation of the urinary tract if possible.

In badly infected cases, with dysuria and frequency interval catheterization and lavage of the bladder may allay the symptoms. Occasionally they aggravate them. If a considerable quantity of residual urine is present which is causing nocturnal incontinence and bed wetting, the best course to pursue is to pass a catheter institute lavage and then empty the bladder when the patient is retiring. This may control the incontinence.

In the most debilitated patients marked improvement may be attained by putting them to bed and inserting an indwelling urethral catheter. Subsequently interval catheterization must be carried out.

In the uncomplicated "tabetic bladder" cases, even when a residual urine of from 800 to 1000 cc. is present and the blood urea nitrogen is normal the bladder should be undisturbed. Treatment in this class of cases should be limited to systemic management. Local treatment must be instituted only to combat imperative complications.

The cystoscope is a most valuable aid in differentiating a paralytic condition from a mechanical obstruction. It should be used only after a thorough routine has been followed. The possibilities of error in interpretation of the cystoscopic picture must be borne in mind.

SYPHILIS OF THE URETER.

Syphilis of the ureter is rare. A case has been described by Hadden¹²² as mentioned by Osler and Gibson.

While involvement of the ureter has been observed in conjunction with bladder syphilis, it is impossible to recognize this condition alone except at autopsy.

Essential Hematuria.—While a great deal of speculation has been brought forward in regard to the etiological factors in essential hematuria few have considered the possibility here of secondary ulcers or the formation of gummata. It might be well in this class of cases to eliminate thoroughly this form of infection before deciding upon some doubtful etiology.

SYPHILIS OF THE KIDNEY

Syphilitic nephritis manifests itself in the following forms

1. Acute parenchymatous syphilitic nephritis.
2. Chronic interstitial nephritis.
3. Amyloid kidney.
4. Gummatous kidney.

Under this heading will be considered only those forms of syphilitic infection in which the symptoms and pathology can be actually attributed to the *Spirochæta pallida* the first and the fourth.

Acute Parenchymatous Syphilitic Nephritis.—**Synonyms.**—Acute early syphilitic nephritis nephritis syphilitica præcox.

The premise that uremia is responsible for the complicating symptoms, or even death, in tabetic involvement of the urinary tract is not necessarily supported by the facts. The urea-nitrogen estimation of the blood in a limited number of tabetics with appreciable amounts of residual urine is usually within normal limits. In rare instances only does it compare with the nitrogenous retention that accompanies a like quantity of urine retained by mechanical obstruction. It seems more plausible to believe that the pains and associated toxic condition of these patients are due to a long-standing syphilitic process and not uremia.

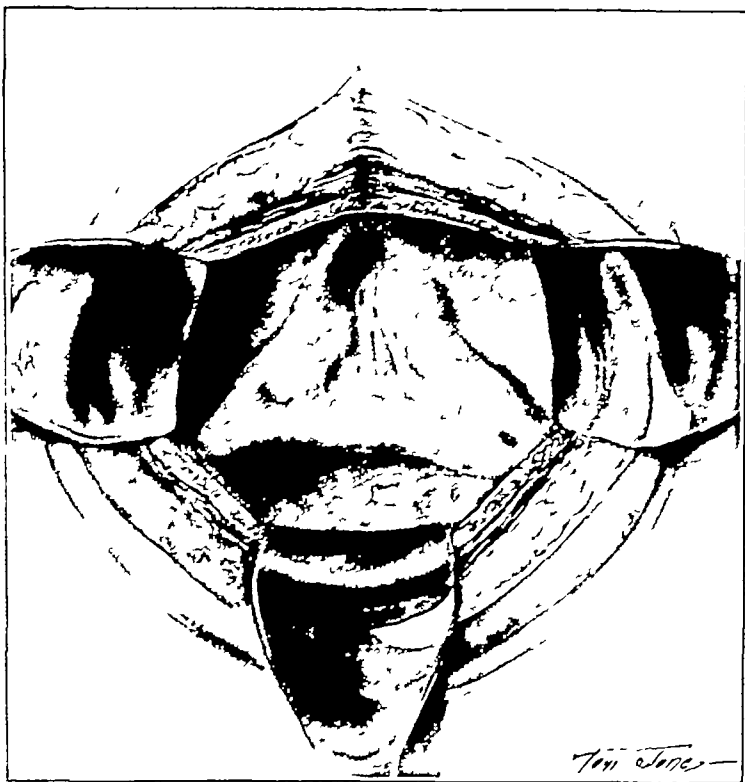


FIG 70 — Hypertrophy of the trigone, with distortion of the bladder neck and floor. Contraction of the muscle of Bell on the left exerts upward traction on the internal vesical sphincter, causing incompetence of the sphincter, resulting in nocturnal incontinence.

Treatment — Treatment is either systemic or local, or both. In the uncomplicated cases of tabetic bladder, treatment should be systemic and not local. The same precautions should be taken in catheterizing a tabetic bladder as in catheterizing a "spinal injury bladder." The less instrumentation and local manipulation the better. The forms of treatment that have been the most satisfactory have been intensive intravenous arsphenamine injections followed by spinal drainage, continued with mercury or bismuth injections or mercury inunctions.

has only been in the last twenty years that the syphilitic etiology in many cases of aortic aneurysm has been recognized.

In Munk's clinic among 260 patients with visceral syphilis showing a strongly positive Wassermann 88 per cent of the men and 81 per cent of the women did not know that they had the infection.

Notwithstanding the advance in our knowledge of visceral syphilis the subject has been more clearly understood only since the introduction of the Wassermann reaction in practice.

During the last ten years considerable literature has accumulated on the subject of syphilis of the kidney. Among the authors who have reported cases are Giordano¹¹ 1923, Bancroft¹² 1930, Miller and Hay¹³ 1930, Fucci¹⁴ 1930, Lereboullet and Felong¹⁵ 1930, Rich¹⁶ 1932, and Tzanek, Jammet and Negreanu¹⁷ 1934.

Etiology—This form of nephritis is a hematogenous injury, not a tissue process, and it is caused by the presence of the *Spirochaeta pallida*. By most authors therefore syphilitic nephritis as well as nephritis caused by scarlet fever and other infectious diseases is attributed to a toxic cause. The idea that the continued administration of mercury in syphilitics causes a nephritis has long been held.

The question of whether the kidney injury in these cases is due to syphilis or to mercury is decided at once by the lipoid findings in the urine, reference to which will be made later. In the nephritis caused by mercury there is never lipoid degeneration; therefore no lipoid casts are found in the urine.

Naturally there are all sorts of transitional forms from very severe cases of nephritis to slight and quickly passing albuminurias, which many syphilographers, especially the French, maintain are very frequent but, according to Hoffmann, are rare in Germany.

Since the discovery of the *Spirochaeta pallida* we are in a position to test its relation to the kidney. In these investigations it has been frequently found in the kidneys of congenitally syphilitic children. They have been reported as having been found in the urine in cases of acquired syphilis.

Recent syphilis can generally be demonstrated by the clinical symptoms, however these may be so masked by severe edema that they are not apparent. It is more difficult to palpate the glands and even the eruption is not so easy to recognize on an edematous skin. Therefore it is particularly important to make a diagnosis either by finding the spirochetes in the urine or by the Wassermann reaction.

From his experience in determining the syphilitic etiology in a given case and from the recent advances in syphilology, Hoffmann formulated the following signs as an indication of early syphilitic nephritis:

1. The demonstration of recent syphilis by clinical symptoms, finding the *Spirochaeta pallida* in primary or secondary lesions, and a positive Wassermann reaction.

2. Characteristic signs in the urine, such as enormous albumin contents and the finding of the *Spirochaeta pallida* in the sediment of the urine removed by catheterization.

The first to acknowledge syphilitic kidney diseases was Bayer¹³⁷ In 1840 he wrote as follows "I have seen cases in which the influence of constitutional venereal diseases seemed so striking that I did not hesitate to attribute, at least to a great extent, the development of kidney diseases to the venereal cachexia"

The first description of kidney syphilis was given by Virchow¹³⁴ in 1858 He observed that simple nephritis is often found in syphilitics, but that that does not justify considering them specific, because they have no characteristic signs

In 1867 Guio¹³⁵ published the first report of syphilitic albuminuria and Perod¹³⁶ the first description of early acute syphilitic nephritis

Karvonen¹³⁷ and Neumann¹³⁸ are among the writers on the subject More recently, Bauer and Habetin,¹³⁹ Hoffmann,¹⁴⁰ Osthelder,¹⁴¹ Welz,¹⁴² Tach,¹⁴³ Moritz,¹⁴⁴ and Damask¹⁴⁵ have written communications, while the excellent monograph of Munk¹⁴⁶ ranks as authoritative on the subject

Owing to the fact that the causative agent in syphilis was so long misunderstood, few realize that during the period of secondary localization (secondary eruption), the spirochetes are actually present in every organ of the human body to a greater or less extent, and the fact that syphilis may cause disease of the internal organs during the eruption of the first exanthem or even for some time before, is recognized possibly by syphilologists alone

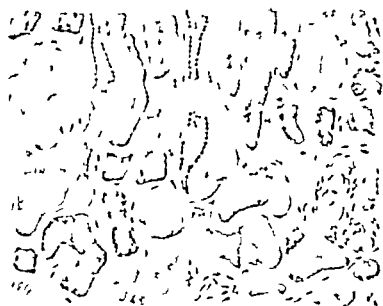
Hoffmann has shown that transmissible spirochetes circulate in the blood three weeks before the outbreak of the eruption

For a long time there has been a great deal of doubt concerning the specific nature of the nephritis appearing in the early stage Senator,¹⁴⁷ an expert himself on kidney diseases, did not admit the real nature of this condition in 1902

In 1926 Hood and Murphy¹⁴⁸ reported a case of acute syphilitic nephritis in the early secondary stage of syphilis In 1928 Lenormand¹⁴⁹ reported the case of a man, aged twenty-three years, in whom the manifestations of syphilis appeared in the kidney before the appearance of secondary roseola on the body The symptoms included albuminuria and edema of the lower limbs The Wassermann reaction was strongly positive Recovery followed specific treatment with mercury There are only a few cases of preroseolic nephritis recorded in the literature and those were simple albuminurias Lenormand's case differs in that it was an acute parenchymatous nephritis In 1930 Rinaldi¹⁵⁰ reported 2 cases of syphilis of the kidney in young persons which demonstrate that the phenomena due to generalized visceral syphilis may be earlier and more common than is believed, and that the exanthema may not be the first manifestation of generalized syphilis In one of Rinaldi's cases spirochetes were found in the urine

We are astonished to find that today a great number of cases of disease of the heart, blood-vessels, liver, kidney, and joints in syphilitics are due to the *Spirochæta pallida*, yet more surprising is the number of syphilitics who do not know that they are affected It

PLATE I



Acute Parenchymatous Syphilitic Nephritis. (Munk.)

3 The influence of specific treatment, which is almost always evident if mercury and salvarsan are correctly used

According to Hoffmann, acute syphilitic nephritis may develop in two ways either gradually, without any specific symptoms, so that it may be overlooked unless the urine is examined, or in a more or less stormy fashion, with marked edema and fluid in the body cavities. However, most patients seek the physician's advice on account of general edema and weakness, this gradually progresses and anemia may be marked

The principal and most characteristic symptom is the anemic appearance of the patient, with a more or less severe edema, the patients complain of a great weariness and weakness, sometimes there is difficulty in breathing, headaches are not very frequent, vomiting, as a rule, appears late, as well as other uremic symptoms

As long as there is no complication the temperature rarely goes higher than 38° to 38.5° C, chills are not present. The only symptom that the patient complains of is that on urinating he notices a small amount of urine

Urinary Findings — These are especially characteristic. The volume varies from 300 to 1200 cc, the color is normal yellow, reaction acid, specific gravity very high, albumin contents generally high, up to 28 per 1000. Microscopically, examination of the urinary sediment shows a small number of red cells, fairly numerous white cells, many epithelial, and a few hyaline, waxy, and granular casts, but most of them lipoid casts. Under the polarizing microscope, in fresh specimens the whole field may be strewn with double refracting drops, some of them in crystalline form and some of them cylindrical

In 1915 Stengel and Austin¹⁵⁸ examined the urine with a polarizing microscope fifty-eight times in 46 cases and 23 showed nephritis with an abundance of albumin and casts in the urine. Of these 23 patients, 6 had a positive Wassermann reaction, 3 had strong presumptive evidence of syphilis, but not a positive Wassermann reaction. Fourteen had not the slightest evidence of syphilis. The 6 patients with the positive reactions all showed lipoids in the urine, whereas in the 14 non-syphilitic cases only 5 showed lipoids in the urine

Pathology — According to Munk, the pathological anatomy of this form of syphilitic kidney, at the height of the disease, corresponds to the so-called large white kidney, a name given it on account of its macroscopic appearance. The color is really not white, but a grayish-yellow, due to the lipoid contents and the cloudy swelling of the cortical substance

The kidney for the most part is flaccid and soft. On the surface of the kidney it is possible to see, at times, individual groups of convoluted tubules appearing as yellow flecks standing out from the remaining grayish-yellow turbid ground substance

On cross-section the cortical substance seems increased in breadth and so swollen that it stands out over the medullary substance. The medullary rays may be recognized as gray, watery stripes, often com-

pletely transparent and gelatinous while the cortical pyramids appear turbid intersected by bright yellow stripes and flecks which are the convoluted tubules which have undergone fatty degeneration. The vessels are not well filled while the vasa recta of the medullary substance are so that there is a sharp contrast in the coloring of the two substances. Plate I gives a picture of a frozen section of such a kidney colored with Sudan hamalaun. The lipoids are colored yellowish red we see the convoluted tubules chiefly attacked by the lipoid degeneration. Besides the lipoid degeneration some parts of the convoluted tubules show a somewhat indistinct appearance. These are in a state of cloudy swelling. The glomeruli are on the contrary, completely intact. The nucleus stains well and the interstitial tissue does not show any changes which indicate inflammatory processes, either cellular infiltration or productive proliferation. We have therefore an organ which has undergone a purely degenerative change. The cloudy swelling itself is a degenerative stage which may pass over into fatty or lipoid degeneration. A noteworthy fact is the rapid appearance of primary lipoid degeneration of the kidney epithelium without any further degenerative or later inflammatory changes.

Clinically this type of syphilitic kidney is an acute nephritis but from the point of view of pathological anatomy it is a degenerative non-inflammatory change of the organ of a chronic character, and can be set in a group by itself as a form of degenerative kidney disease peculiar to syphilis (Munk).

Symptoms.—The leading symptoms of nephritis following infectious diseases are marked anemia and a considerable degree of dropsy which is a drop of the body cavities rather than a general anasarca as in syphilis. Headache and rise of temperature are only exceptionally observed in uncomplicated cases. Marked uremia is unusual if there is not a considerable degree of stasis the liver and spleen are involved only moderately if at all. Murmurs may be demonstrated in the heart from time to time but they are generally due to anemia. Accentuation of the second aortic sound is rare at least in the beginning and at that time there are no signs of increased blood pressure.

The symptoms of nephritis may appear in a few months or not until some years after the infection. The Wassermann reaction may be strongly positive or only weakly positive. However a positive Wassermann reaction is not sufficient to decide the question whether in a given case we have a syphilitic nephritis or merely nephritis in a syphilitic patient but it fills the gap in the history of patients who do not know that they have the disease and it increases the number of demonstrable syphilitic cases in which the nephritis is observed.

Urinary Findings.—These are of the greatest importance. The daily amount is small sometimes as little as 300 cc. The urine is turbid yellow or brown in color and macroscopically only rarely shows blood. The reaction is always acid specific gravity high sediment abundant. Its chief constituents are double refracting lipoid substances which are sometimes free in individual droplets or clumped

According to Munk's views a fatal outcome in the acute stage is very rare in spite of the severe symptoms such as dropsy, anemia, weakness and so forth.

Hoffmann says: "The prognosis of early acute syphilitic nephritis which was good before has become even better since the introduction of arsphenamine.

We have two powerful remedies both being harmless if properly used. In the majority of cases the albuminuria is completely overcome. Death is rare and when it occurs is perhaps due to improper treatment. The quick cure is due to the double action of arsphenamine and mercury against the spirochetes through the blood and urinary tubules.

Treatment.—In every case of syphilis which is presented for examination and treatment a careful urinalysis should be made and if later on an albuminuria presents itself its etiology will not be so obscure. If a patient comes for treatment at the height of his disease it is generally extreme dropsy and oliguria that demand attention. As this condition is caused by the presence of the *Spirochaeta pallida* within the substance of the kidney, as soon as specific remedies can be applied (arsphenamine, mercury, bismuth) the condition should improve. Small doses of arsphenamine should be given as soon as possible and rubbings or bismuth may be combined as soon as the dropsy has disappeared.

Sezary¹²⁹ says that all syphilitic medication is harmful to the kidneys. Arsenic, mercury and bismuth injure the kidneys in many ways and more so if the kidney filters are already damaged when treatment is begun. So it is imperative that a careful urine examination be made in all patients who present themselves during the early stages of treatment in order to ascertain whether the albumin that may or may not be present is caused by the *Spirochaeta pallida* and not by the medication. Sezary says that pentavalent arsenic and potassium iodide should not be used in the case of syphilitics when the urinary excretion is impaired. Regarding the bismuth he believes that almost all the so-called bismuth nephritis are in reality toxic infectious and are the result of the action of the germs of stomatitis. Classifying the lesions caused by the different medicaments, he states that mercury generally causes toxic nephritis, arsenic provokes either (after the first injection) a reactivation of renal lesions or (in the advanced period of treatment) an allergic nephritis. Bismuth increases the virulence of the buccal or other germs. Sezary believes that danger can be avoided by employing small doses of different antisyphilitic medicaments. In the case of arsenic trivalent arsenic should be employed which should be preceded by eight or ten small injections of cyanide of mercury commencing with 0.25 and progressing to 1 centigram daily. The tolerance of every syphilitic patient to any kind of medication should be strictly watched.

Avramovici,¹³⁰ on the basis of certain case reports and clinical facts concludes that the kidney is not only fatally and inevitably affected

together, or they may appear as fine dioplets in the numerous epithelial cells, but a more characteristic formation is that of large opaque casts. Pure hyaline and granular casts are found, but they are rare. There are also considerable numbers of leukocytes, the mononuclear form predominating.

It is true that lipid substances occur in the urinary sediment in secondary contracted kidney, but not in such amount as in parenchymatous syphilitic kidney, and the albumin contents also are lower.

Munk says that greater difficulties lie in differentiating this form of kidney from a large white amyloid kidney. The urinary findings are quite similar, but the amyloid kidney is distinguished by the fact that in addition to lipoids it has relatively numerous single refracting fat elements. These two forms of disease are different also in the time of their appearance. While amyloid kidney generally develops slowly, still it leads to severe clinical symptoms, syphilitic disease appears early with very severe symptoms, especially marked dropsy. Within ten days after the first appearance of albumin in the urine, the condition may become threatening.

Munk hopes that this form of acute parenchymatous degenerative kidney will be more often recognized in the future, since it can be recognized only by means of examination of the sediment by the polarizing microscope.

Unfortunately, most patients who come to the medical clinics have severe symptoms, and as a consequence this makes the number of cases appear relatively small, but there is no doubt that there are a large number of patients with mild symptoms that are observed and treated by syphilographers.

Differential Diagnosis — Differential diagnosis can be made between acute parenchymatous syphilitic nephritis and nephritis resulting from other infectious diseases.

Prognosis — In most cases, with proper treatment and care, the patients recover from the first stage, even when there has been high-grade edema and weakness of threatening character. The edema may last two or three weeks, or may disappear earlier, sometimes very rapidly. The quantity of urine increases, the formed constituents in the urine decrease, but the albumin contents remain rather high. As soon as the edema disappears completely, the patient usually regains his strength and appetite and normal conditions return. The headaches gradually pass away. The amount of urine may vary for awhile in the formed elements, especially lipoids may be observed from time to time, but it is the high albumin contents that may persist for months afterward, rising and falling indefinitely.

The relatively benign course of acute parenchymatous syphilitic nephritis is surprising, and like all other forms of syphilitic infection, the prognosis depends on the prompt diagnosis, for the longer the kidneys remain jammed with spirochetes with their attending systemic symptoms, the more difficult will it be to bring about permanent resolution.

GUMMA OF THE KIDNEY

While in the earlier editions of this work it was stated that gumma of the kidney is rarely recognized except at autopsy we must believe from the case reports that have been published since then that it is possible to diagnose gummatus lesions of the kidney by pyelographic study supplemented by the Wassermann test and the results of anti-syphilitic treatment. The following are all of the reports of cases cited in the literature.

Maderna¹⁴¹ reported the case of gumma of the left kidney in a man aged thirty-five years. Radiography showed cavernous lesions of the kidney. The diagnosis was confirmed by the results of specific therapy. The author cited 15 cases that have been reported in the literature.

Leebman¹⁴² described the case of a man aged thirty-one years. A gummatus node perforated into the kidney pelvis. The diagnosis was made on the basis of the pyelogram and the complaints of abdominal pains. There was hematuria. The Wassermann reaction was 3+. No bacteria were found in the urine. A retrograde pyelogram of the left kidney showed tumefaction of the calices and other changes as indicated by the filling defects. Specific treatment resulted in cure. The author considered this to be a case of gummatus tumor.

Other cases of gumma of the kidney have been reported as follows: Tengel 1861, Cornil 1864, Lancereaux 1864, Beer 1867, Cuffer 1873, Greenfield 1876, Klebs 1876, Spicars 1877, Key 1877, Huber 1878, Seiter 1882, Bowlby 1897, Sirovieza and Mihaly 1921, Felber 1926, Ruiz 1926, Chatellier and Laurentier¹⁴³ 1927, Sklarz 1928, Mariauschik 1927 and Ichikawa and Kobayashi¹⁴⁴ 1933.

Gummatus disease of the kidney generally appears in the form of circumscribed milium nodules varying in size from that of a grain of millet to that of a hazel nut which as a rule are limited to one kidney. They generally occur in the cortical substance extending at times more or less deeply into the medullary substance even as deep as the papilla. Occasionally a single gumma occurs but usually they are multiple.

On section these gummata show a peripheral part which is gray and transparent. They may be either soft or hard with a necrotic center consisting of caseous masses undergoing fatty degeneration. The periphery consists of tissue which is rich in cells and vascular tissue. In this tissue or sometimes surrounded by it there are atrophied urinary tubules together with shrunken Malpighian bodies.

When these gummata have evacuated their contents they may be resorbed by the lymphatics of the kidneys, and when superficial leave in their places cicatrices with corresponding deformities.

Symptoms.—As in gummata elsewhere gummata of the kidney manifest themselves from seven to twenty years after the chancre first appears. The evolution of the gumma is slow and insidious and only exceptionally gives symptoms which permit of a diagnosis during life. In some cases however gummata that open into the pelvis of the kidney may soften and discharge their contents into the urine.

by syphilis itself but also by its treatment. The renal lesions, due to medicamental elimination, are practically irremediable, often an acute lesion becomes chronic and remains incurable. The filtering power of the kidney should be observed continually during antisyphilitic treatment. As a result of syphilis, the kidney may pass through the whole gamut of anatomical and functional lesions, from a simple and slight urinary disturbance to total destruction of the organ. A badly functioning kidney should be helped as much as possible by other methods of elimination. In any case, alternations of therapeutic measures should be the rule so as to prevent the development of intoxication.

Unfortunately, diuretics do harm, the chemical irritation caused by them causes the degenerated epithelium to be discharged suddenly and in large quantities. Such a considerable desquamation of kidney elements is not without danger for future restoration of the kidney. Diuretics, if used at all, should be of the mildest form, diuresis should be taken care of in a compensatory manner by free saline catharsis. Whenever the anasarca has advanced to a considerable degree, skin drainage may be resorted to.

As soon as possible small doses of neoarsphenamine should be given. It is perhaps best not to give over 0.2 or 0.3 gm. at a dose, and, as soon as the dropsy has disappeared, rubbings may be combined.

Hoffmann gives arsphenamine the preference in nephritis. It does not cause irritation of the kidneys, except in very rare cases. Some authors hold that it is sufficient to effect a cure.

The dietetic management in this class of cases deserves some little attention. Eggs, milk and carbohydrates are used as an exclusive diet in the beginning. Munk recommends some form of malt extract to be added to the milk, and, on account of the severe anemia, iron is given as soon as the intestinal tract will stand it. Meat should not be withheld long.

The use of baths and hot packs is contraindicated in this form of nephritis, because the advantage to be gained from them is not in proportion to the bad effects they have in increasing the general weakness.

The general specific treatment for the syphilitic condition must, of course, be carried on, regularly controlled by the Wassermann reaction.

CONCLUSIONS — Munk's conclusions are as follows.

In the clinical diagnosis of nephritis more attention must be paid than heretofore to the different degenerative processes in the kidney. The examination of the urine may give valuable information on this point.

The demonstration of fat and fat-formed elements in the urine points to a fatty degeneration of the organ in the different forms of cachexia. The presence of a greater or less amount of fat-formed elements shows the destruction of kidney parenchyma in acute forms of nephritis.

The demonstration by means of the polarization microscope of double refracting lipoids in the sediment of the urine is a reliable criterion for differential diagnosis between acute inflammatory and chronic degenerative kidney diseases.

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As soon as this elimination of the contents occurs, the urine again becomes macroscopically clear, the condition remaining undiagnosed, thus leaving the true cause unsuspected

Gummatous kidney, when greatly enlarged, may simulate a malignant tumor. In such instances, even in the absence of positive symptoms of syphilis, a Wassermann reaction may clear up a doubtful diagnosis. The possibility of a tuberculous kidney should be constantly kept in mind.

Prognosis — Unless the attending interstitial nephritis is advanced, the prognosis is good.

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SECTION II

THE PENIS AND URETHRA

CHAPTER IV

ANATOMY ANOMALIES AND INJURIES OF THE PENIS

By ARTHUR B. CECIL, M.D. F.A.C.S.

ANATOMY OF THE PENIS

THE great bulk of the penis is composed of three erectile bodies one on each side and dorsally known as the corpora cavernosa and between these on the ventral surface a third body the corpus spongiosum or the corpus cavernosum urethrae. The upper surface of the penis is spoken of as the dorsal surface and the lower or scrotal surface is spoken of as the ventral surface. The average length of the penis at rest is from $2\frac{1}{2}$ to 4 inches and when erect from 5 to 7 inches. The size of the penis does not bear a constant relationship to the size of the individual and varies more in this relationship than any other organ of the body. The penis may be roughly divided into a perineal or buried portion and a pendulous or exposed portion. It is further customary to divide the penis into a root body cervix and glans. The root is composed of the crura of the corpora cavernosa which are attached to the inner margins of the ischio-pubic rami and the bulb which is in proximity to the triangular ligament. The body or that portion of the penis from the penoscrotal junction to the cervix is composed of the two corpora cavernosa and the corpus spongiosum. The cervix is the constriction between the body and the glans. The glans penis is a prolongation of the corpus spongiosum. It is somewhat conical and has been likened to an acorn from which circumstance it has been called the balanus. At the base of the glans penis there is an elevated prominent margin the corona. The glans penis anteriorly and somewhat ventrally presents a vertical fissure the urinary meatus.

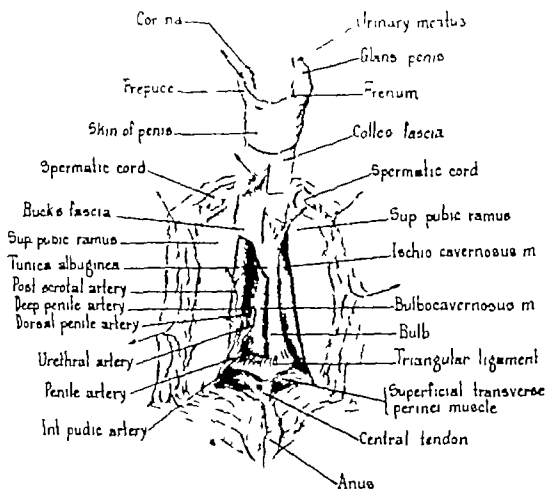
Corpora Cavernosa.—The corpora cavernosa form the chief bulk of the body of the penis and for the most part consist of large venous spaces. They are enclosed in a dense fibrous envelop known as the tunica albuginea which is continuous with the trabecula between the blood spaces. The corpora cavernosa take origin from the ascending rami of the ischium and the descending rami of the pubis. They converge to meet just in front of the arch of the symphysis pubis.

These perineal extremities are known as the *crura penis*. On each side the *crura* are invested by the *ischiocavernosus* muscle. These muscles arise from the tuberosities of the *ischium* and run obliquely and upward and are inserted into the lateral fascial covering of the *corpora cavernosa*. By their contraction they compress the cavernous bodies and thus aid in erection. Such a function has been disputed by Cadiat¹. The cavernous bodies are at first separated by an interval which is occupied by the bulk of the *corpus spongiosum*. They unite just beneath the arch of the symphysis and lie side by side throughout most of their extent and terminate anteriorly in conical extremities over which the *glans penis* fits like a cap. The anterior portion of the fibrous partition between the *corpora cavernosa* is perforated by numerous apertures through which the blood spaces and small arterioles communicate. This more or less imperfect septum in the distal portion is designated as the *pectiniform septum*. On approaching the *glans* the *corpora cavernosa* again are completely invested by fascia as separate bodies.

Corpus Spongiosum.—The *corpus spongiosum* or *corpus cavernosum urethræ* is also composed of erectile tissue and lies ventrally between the two bodies of the *corpora cavernosa*. It begins in a broadened extremity near the triangular ligament known as the *bulb* and ends anteriorly in another expansion known as the *glans penis* which fits over the distal ends of the *corpora cavernosa*. The broadened extremity at the triangular ligament is surrounded by the *bulbocavernosus* muscle. This muscle arises from the central tendon of the perineum completely surrounding the *bulb*. By its forceful contraction fluid, urine and semen, which collect in the bulbous urethra, are expelled. Both the *bulbocavernosus* muscle and the *ischiocavernosus* muscle are innervated by branches of the internal pudic nerve and receive their blood supply from branches of the internal pudic artery. Almost the entire *corpus spongiosum* is transversed by the urethra. The only part which is not is the *bulb*, the major part of which lies behind the urethra. The *corpus spongiosum* is also invested by a fibrous sheath, the *tunica albuginea*, as are the *corpora cavernosa*. The erectile tissue of the *glans penis* is continuous with that of the *corpus spongiosum*. There is no direct vascular communication between the *corpus spongiosum* and the *corpora cavernosa*.

Coverings of the Penis.—The superficial covering of the penis differs in different portions. The body is covered with a thin skin, loosely attached, without fat and possessing only fine hair (*lanugo*) except in the region of the pubes. The skin is freely movable over the penis which, therefore, lends itself easily to plastic operation in this region. At the cervix the skin is folded on itself to form the *prepuce*. At the orifice of the *prepuce* the skin of the penis changes in character. The skin lining the *prepuce* and covering the *glans* is modified so that it somewhat resembles mucous membrane. It is entirely devoid of hair and there are small sebaceous glands in the region of the corona and over the inner layer of the *prepuce*. These glands were first described

PLATE II



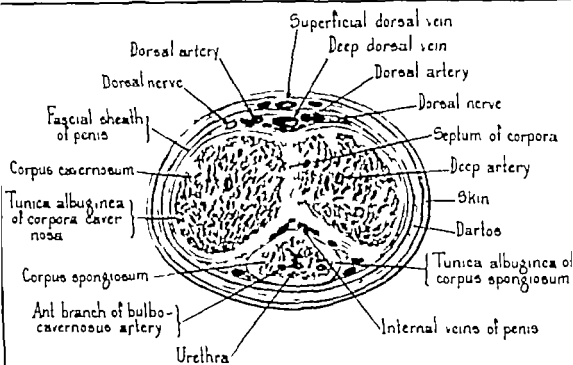
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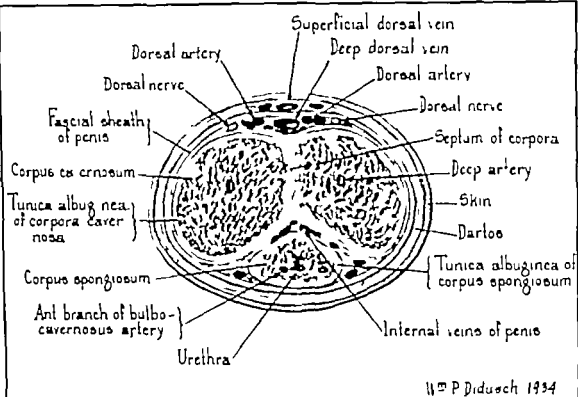
Coverings of the Penis—The superficial covering of the penis differs in different portions. The body is covered with a thin skin, loosely attached, without fat and possessing only fine hair (lanugo) except in the region of the pubes. The skin is freely movable over the penis which, therefore, lends itself easily to plastic operation in this region. At the cervix the skin is folded on itself to form the prepuce. At the orifice of the prepuce the skin of the penis changes in character. The skin lining the prepuce and covering the glans is modified so that it somewhat resembles mucous membrane. It is entirely devoid of hair and there are small sebaceous glands in the region of the corona and over the inner layer of the prepuce. These glands were first described

PLATE III



W. P. Didusch 1934

PLATE III

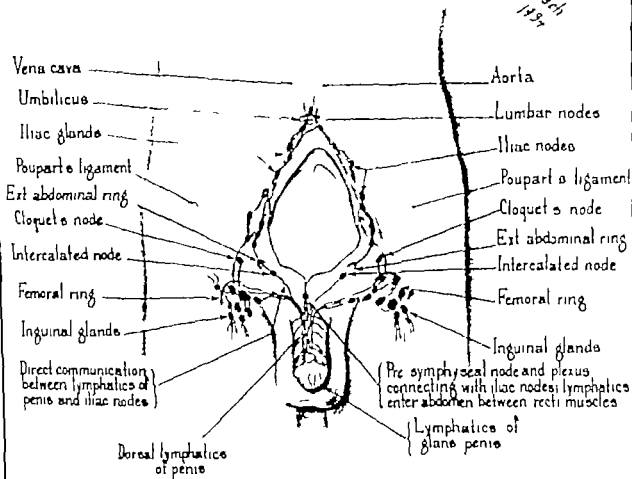


in the orang by Tyson. They are supposed to secrete unctuous material which mixed with discarded epithelial cells make up the secretion known as smegma. Some histologists have denied that any glands existed in this region and attribute formation of smegma entirely to the breaking down of discarded epithelial cells. The transformed epithelial covering over the glans is closely attached at the cervix of the penis and intimately covers the glans to meet the mucous membrane of the urethra at the meatus. The prepuce reflects on the two sides and finally meets along the under surface of the glans in a sharp median fold known as the frenum. This extends as far as the ventral border of the urethral opening. The two layers forming the prepuce are separate thus permitting the obliteration of the preputial sac and uncovering of the glans by retraction of the skin. The subcutaneous tissue of the penis is very loose in texture and permits of ready movement. Along the under surface of the penis are bundles of involuntary muscle fibers closely adherent to the integument constituting a stratum the dartos muscle of the penis that resembles the similar layer of the scrotum. Buck's fascia forms the common sheath of the erectile bodies. It arises from the symphysis pubis by a triangular bundle of fibers the suspensory ligament of the penis and from the pubic rami at the attachment of the anterior layer of the triangular ligament. Thence it runs forward surrounding the corpora cavernosa and the corpus spongiosum in two separate compartments. The cavity of Buck's fascia is bounded anteriorly by the base of the glans penis and posteriorly by the triangular ligament. Colles fascia begins also at the triangular ligament and extends forward as the deep layer of the superficial fascia to scrotum penis and belly wall. Hence peri urethral cellulitis and extravasation are confined within these limits for an indefinite time escaping where the fascia blends with that covering the pubes and leaves a loophole into the subcutaneous tissue of the abdominal wall (keys² after Wesson²).

Lymphatics — The collecting trunks from the penis and urethra run circumferentially around the penis those from the glans in the coronary sulcus the others at intervals along the shaft. On the dorsum of the penis they join to form a number of longitudinal channels the dorsal lymphatics which are usually near the midline but may lie a good distance laterally thereto. These channels anastomose somewhat but, in general those from the penile skin and prepuce glans and penile urethra remain distinct and make three separate groups, which follow quite different paths after passing the root of the penis. (1) The channels from the prepuce frenum and penile skin turn to right and left and run to the inguinal glands mostly the upper medial nodes of the superficial layer but a few to the deep nodes close to the femoral vessels. There may be one or two tiny intercepting nodes just at the base of the penis. (2) The channels from the glans anastomose to form a small plexus in front of the symphysis. From this plexus channels go (a) to the inguinal nodes mostly the deep ones—Cunco believes that no channels from the glans go to the superficial

PLATE IV

Wm P D Busch
1897



inguinal nodes—(b) through the crural canal under Poupart's ligament to the external iliac nodes, and (c) a constant channel, usually single, lying under the spermatic cord and passing through the inguinal canal to enter an external iliac node. There may be a small intercalated node at the external inguinal ring. (3) The channels from the urethra go (a) to the deep inguinal glands (few), (b) the iliac glands *via* the femoral canal, (c) by a single channel passing over the symphysis between the insertions of the recti abdominales and then laterally along the inner surface of the abdominal wall to the external iliac or internal epigastric nodes, (d) by anastomotic channels along the dorsal vein of the penis to join under the symphysis the channels from the membranous urethra, which are drained by the pudic and prevesical channels into the internal iliac (hypogastric) group of nodes.

While it is common to see metastases in the inguinal glands, intrapelvic masses are by no means rare, and one can see from the above synopsis how they may occur even in the absence of inguinal involvement. Such cases are reported (Young⁴).

Arteries.—The hypogastric or internal iliac artery divides into two large branches, an anterior and a posterior trunk. The anterior trunk is the internal pudic artery which gives most of the blood supply to the penis. The penis has a deep and superficial blood supply. The superficial arteries supply the integument and the associated envelopes, whereas, the deep arteries supply the erectile masses.

The superficial arteries consist of (1) branches from the external pudic, which comes off from the femoral artery. These supply the lateral and ventral surfaces of the penis, (2) the dorsal arteries, branches of the internal pudic, supply the ventral surface and the prepuce, (3) and further there is a superficial perineal supply of small vessels to the posterior urethral surface.

The deep arteries of the penis are all branches of the internal pudic. They supply the three cylinders of erectile tissue including the glans.

The corpus spongiosum is supplied by the arteries of the bulb. These extend along the urethra as far as the glans where they anastomose with branches of the dorsal arteries.

The corpora cavernosa are supplied by arteries which enter the crus penis and run forward in the corpus cavernosum along the side of the pectiniform septum. The vessels of the two corpora cavernosa communicate with one another by anastomotic twigs that pass through the apertures in the median septum as mentioned above and also anastomose at the terminal loop. The cavernous bodies are further supplemented and supplied by twigs from the dorsal arteries that pierce the tunica albuginea.

The dorsal arteries of the penis pass along the dorsum between the fascia and the tunica albuginea together with the dorsal nerves and veins. These arteries distribute twigs to the coverings of the penis, to the cavernous bodies and small twigs pass around the corpora cavernosa to the corpus spongiosum.

The various arteries of the penis anastomose freely.

PLATE IV

Wm P. Jusch
193-

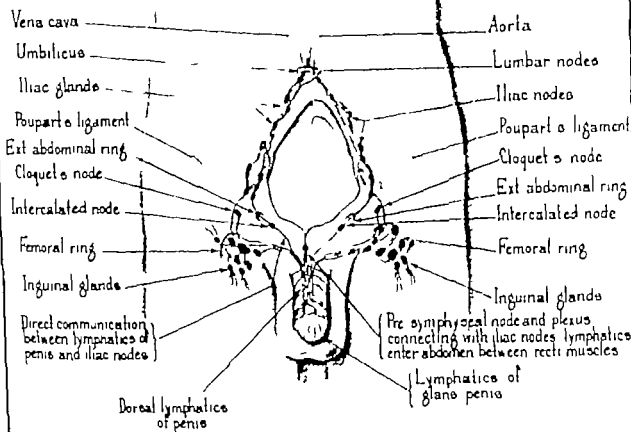
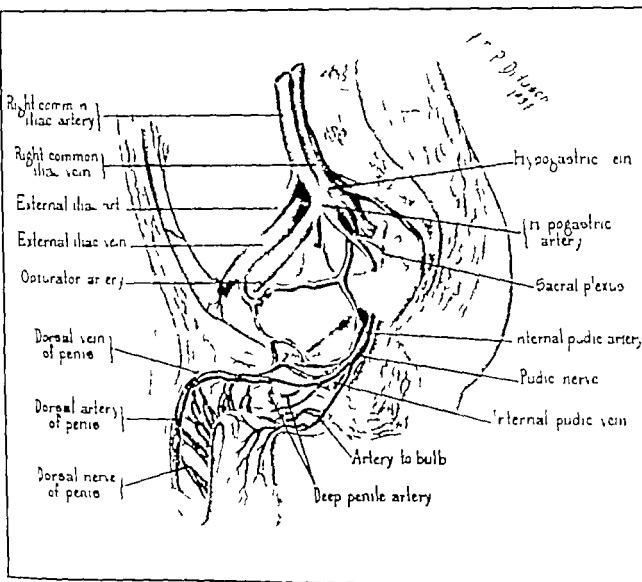


PLATE V



Veins.—The large venous trunks of the penis consist of superficial and deep vessels.

The superficial dorsal vein lies beneath the skin and terminates by either emptying into one of the branches of the internal saphenous vein or into the femoral vein or by joining the deep dorsal vein.

The deep dorsal vein begins above the corona by two stems that collect branches from the glans and prepuce and as it courses upward receives tributaries from all three cylinders of erectile tissue.

Those from the corpora cavernosa either pierce the tunica albuginea as short branches that pass directly into the dorsal vein or emerge from their under surface along the urethral groove and wind around the body of the penis to reach the collecting trunk on the dorsum. These are known as circumflex veins. The deep dorsal vein which may have received the superficial dorsal vein pierces the tissues at the root of the penis and enters the pelvis to join the prostatic plexus. Where the crura of the corpora cavernosa diverge other deep veins of the penis are formed. These communicate with the prostatic plexus and are tributaries of the internal pudic veins.

The corpus spongiosum is drained by anterior branches that convey the blood to the dorsal vein by joining the circumflex or other veins from the corpora cavernosa and by posterior branches. These latter empty into the prostatic plexus and internal pudic veins.

Nerves.—The penis is supplied by both cerebrospinal and sympathetic nerves. The cerebrospinal nerves are derived from the ilio-inguinal, the posterior femoral cutaneous and the dorsal nerves. The dorsal nerves are branches of the pudic. The branches of the posterior femoral cutaneous and ilio-inguinal nerves supply the integument about the root of the penis while the body of the penis and prepuce are supplied by cutaneous branches of the dorsal nerve. The pudic nerves send branches to the cavernous tissues and each corpus cavernosum receives a deep branch from the dorsal nerve.

The sympathetic fibers pass by way of the dorsal nerve of the penis to the erectile bodies. The *nervi erigentes* is supposed to be especially concerned with erection. In the skin of the glans and prepuce are found special nerve endings the spherical end-bulbs of Krause the genital corpuscles of Retzius and the tactile corpuscles of Meissner.

Erectile Tissue.—The arteries that convey blood to the erectile bodies of the penis are of two kind those that nourish the tissue themselves and those that carry blood to the venous spaces. The blood spaces are not directly connected with the arteries but are connected with them by small tortuous branches which run in the trabeculae that separate the blood spaces. The blood spaces are regarded as venous spaces and are situated between the arteries and the veins. The blood spaces or lacunae are lined by a single layer of endothelial cells outside of which is the fibro-muscular tissue of the surrounding trabeculae. It is the engorgement of these blood spaces that produces erection. The mechanism of this engorgement is not clear. In 1869

Ercolani⁵ noted that the intima of the penile arteries was folded and projected into the lumen. This infolding he believed permitted great dilatation of the artery during sexual stimulation but decreased the lumen of the vessel during flaccidity and limited the inflow of blood. Ebner,⁶ Eberth⁷ and Kiss⁸ believed that these intimal thickenings were more or less valves that controlled erection. They believed that during sexual excitement these valves were drawn back eccentrically and allowed the sudden influx of a large quantity of blood, while during the quiescent period the valves permitted only sufficient blood for nourishing the tissue to pass through them. Hirsch,⁹ in a study of the penile arteries, states that he has been able to demonstrate the so-called arterial valves, but considers them not to be valves but pathological arterial changes.

CONGENITAL MALFORMATIONS OF THE PENIS

Hypospadias and Epispadias.—The first efforts toward the surgical treatment of congenital defects of the urethra were those of Dieffenbach¹⁰ who, in 1836, attempted to cure minor degrees of hypospadias by freshening the edges of the tissues and uniting them with needles. In 1869 Thiersch¹¹ devised his ingenious operation for the treatment of epispadias, and in 1874 Anger,¹² using Thiersch's operation, succeeded in curing a case of penile hypospadias. During this same year appeared the contributions of Duplay,¹³ who again published articles on the treatment of hypospadias in 1880 and in 1886. Since then an enormous number of articles on this subject have been published, the number testifying to the difficulties encountered. Surgery of these conditions, however, is now on a sound basis and the cure of hypospadias and epispadias is an accomplished fact.

In doing plastic surgery for the cure of deformities of the urethra there are certain general considerations which are necessary. These are quite apart from the ingenious methods which have been devised for the treatment of hypospadias and epispadias, but have in the past been tremendously neglected and yet they are extremely important and essential. Undoubtedly very many splendid operations have been ruined by the neglect of some small detail. It is only by meticulous attention to detail that one can hope for any possibility of uniform success.

Davis¹⁴ has recommended that the operative field be scrubbed with soap and water with gauze and that this preparation be followed by ether. He thinks that iodine is likely to irritate the skin. It has been my experience that 3.5 per cent iodine immediately washed off with alcohol is most satisfactory. One should bear in mind that the hypospadiac urethra is likely to be a source of infection unless it is also sterilized. For this purpose Bidgood¹⁵ has recommended the injection of 2 per cent mercurochrome.

In regard to sutures the earliest material used, that is to say, following the days of pins, was silver wire. Duplay thought that this

was the best. More recently Hagner¹⁶ has laid great weight upon the use of silver wire. I have found that for buried sutures in making urethral flaps 0000 (4-0) Hal-Dermic sutures manufactured by Davis and Geck to be very efficient material. For the suturing of the skin I have used black silk or dermal. Where one needs quite strong tension sutures such as in bringing the corpora cavernosa together in epispadias, I have used No. 00 chromic catgut. In all instances I have used interrupted sutures in spite of the fact that this has the disadvantage of numerous buried knots. To obviate this Beck¹⁷ suggested that the sutures be tied within the urethra as one goes along.

One of the greatest causes of failure in doing plastic work on the urethra is inattention to the absolute stasis of blood. No skin flaps can possibly heal if there is an intervening blood clot. One does not like to put any more knots under the skin than necessary but if there is the slightest tendency toward bleeding the points must be ligated. For this purpose I have used 0000 (4-0) Hal-Dermic sutures. Bleeding points are not of course confined to open operations. Nove-Josserand¹⁸ found in tunnelling that in a number of instances sinuses occurred because of blood clots which had formed along the tunnel and later broke down and ruptured through the skin.

The methods for diverting the urine from the field of operation differ with different conditions and different operations. In the Ombrédanne¹⁹ operation no diversion is used. In the Bucknall²⁰ operation some have considered a retention catheter sufficient. However in many plastic operations on the penis diversion is essential. In reconstructing the urethra in perineal hypospadias one cannot improve upon the hypospadiac opening for voiding urine until all other plastic work is finished. The urethra should be reconstructed down to within 1 cm. of the opening and then a suprapubic drainage done for the closure of the perineal and newly reconstructed urethral openings. This drainage should be done about ten days previous to doing the plastic work on the perineum. There is no advantage in doing it at the same time, and there is advantage in having it well established. For the suprapubic drainage tube where it is necessary over a period of time I have used a tube which I devised as shown in Fig. 71²¹ which consists of a catheter passed through a rubber disk the rubber disk being strapped to the abdomen. Pezzer catheters are difficult to get out difficult to clean and liable to break off. It is my impression in operating on children that they form lime salts that plug drainage tubes more frequently than adults and I believe that this is concerned with childhood metabolism. Where one is operating for penile or penoscrotal hypospadias by the Thiersch technique a perineal opening can be quickly made by cutting to the tip of a slightly curved sound. While the sound is in position a suture is thrown around it as recommended by Young⁴ in order that no urine can possibly pass into the urethra and into the newly operative field (Fig. 72). I do not believe that it is possible to maintain a dry field without this suture about the urethra. The suture should be tight enough to occlude the urethra,

but not tight enough to cut the urethra, through, in which event it would defeat its purpose. As a rule it will cut through the tissues somewhat but this does no particular harm and does not cause stricture.

Thiersch, who first introduced perineal drainage for the purpose of diverting the urine in the treatment of defects of the urethra, did so

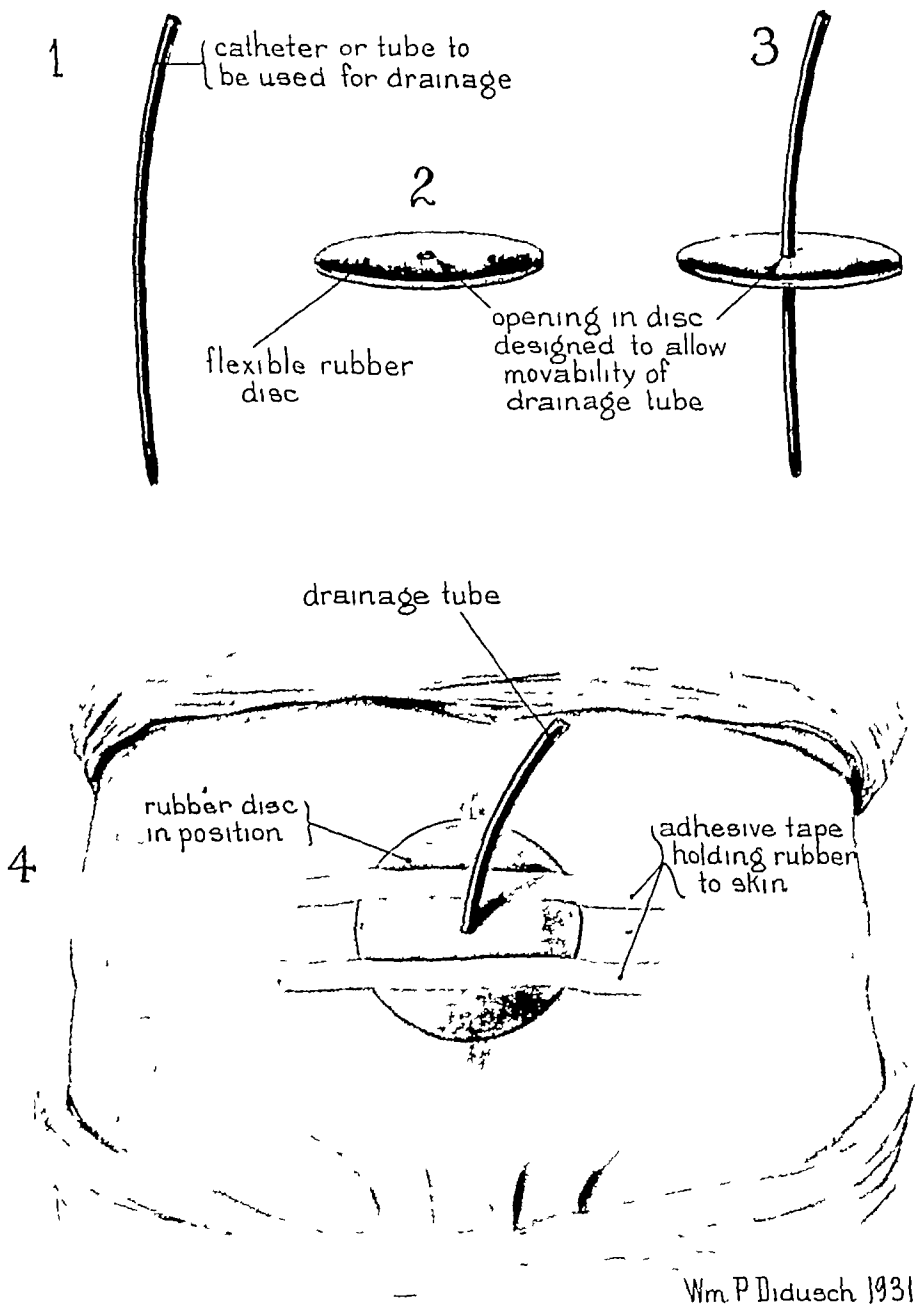


FIG 71 —Author's suprapubic drainage tube *

* Figs 71, 72, 79-88, 110-112 are reprinted from the Transactions of the American Association of Genito-Urinary Surgeons, 1931

not only to divert the urinary stream away from the field of operation which he found that it would not completely do but he thought it was a good thing to do anyway as it kept the patient's bed drier. Now in operating for penile and penoscrotal hypospadias it is only necessary to do a perineal drainage. This is quite different from the matter of bringing about an anastomosis in the case of perineal hypospadias.

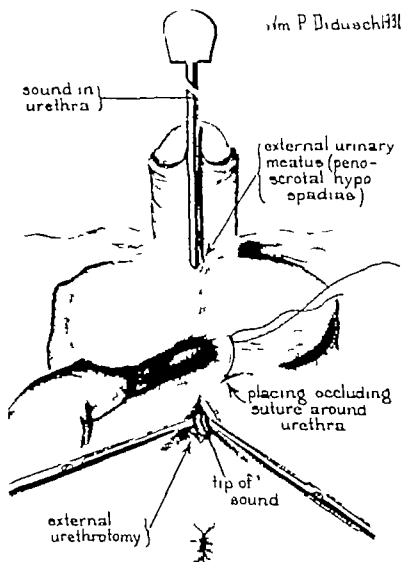


FIG. 77.—Perineal drainage and ligation of the urethra after Young.

where I believe it is well to divert the urine by means of a suprapubic drainage at the time the anastomosis is attempted.

Among some of the earlier operations done for the cure of epispadias perineal drainage was carried out previous to attempting to do anything in order that the skin might be cured of excoriations due to urine. Suprapubic drainage done at the time of repair of the internal sphincter will accomplish much the same thing and allow the excoriated portion

of the penis to become normal for the subsequent plastic operation for reconstruction of the urethra and repair of the external sphincter

It has been recommended that drainage be done at the time of operation for the correction of the deformity in hypospadias. It is possible that one might get a somewhat cleaner skin healing, but when it is considered that this operation for the correction of the deformity of the penis should be done very early in life and that the subsequent operation of reconstructing the urethra is to be done several years later, it does not seem advisable to do any type of drainage to divert the urine at the time of the correction of the deformity, as such drainage procedures would almost surely infect the child's bladder and very little is to be gained as a matter of diverting the urine now. The skin will always heal and so much time must elapse between this correction of the deformity and the plastic work done for the reconstruction of the urethra that scarcely any scar will be found at the time of doing the later operation. So important is drainage, however, that when the plastic reconstruction of the urethra is done I have found it justifiable to establish a week or ten days before, a suprapubic drainage in addition to a perineal drainage where I have been operating for penile or penoscrotal hypospadias. The two drainage tubes are much more likely to prevent trouble and to assure a smooth convalescence, and so many things can go wrong with drainage tubes.

Dressings used after plastic operation should be of plain gauze, fitting the penis fairly snugly in order that the tissues might be held quite firmly together, but again the avoidance of too great pressure is a matter that must be most carefully observed. In operating on the urethra where it is carried down to the perineum and the patient is using the perineal hypospadiac outlet for the voiding of urine, I believe it is useful to protect the lower portion of the wound by rubber dam. Careful nursing is here most essential in order that the dressing may not become sopped and left wet in contact with the wound.

I now come to what I believe to be the most essential consideration in the cure of hypospadias, namely, constant and continuous nursing with personal supervision. Nurses are very likely to consider these patients as ill people and to nurse the boy rather than the region of the wound. So many things can go wrong with these operations that I am convinced that under no pretense whatsoever, should they ever be left in the first ten days after the plastic work. Much more depends upon the above general principles in the curing of these conditions than by any type of technique which has been invented for the reconstruction of the urethra. I believe that a close observation of these principles would make most of the operations which have been devised successful. I am sure that a neglect of them would only in the rarest instance permit any of these operations to be successful. In addition to the above I would refer to the work of Churchman²² who has laid down some very interesting principles of plastic surgery as applied to the treatment of congenital defects of the urethra.

Hypospadias.—Hypospadias is a malformation due to an arrest of fetal development of the penis and urethra in which the external urethral orifice opens at some point on the ventral surface of the penis back of its normal position. The deformity consists not only of an abnormal opening of the urethra but always of an associated abnormality of the penis and in many instances of the scrotum and position of the testicles. The constant accompaniments of the abnormal opening of the urethral orifice in hypospadias are a hooded foreskin, absence of the frenum, a downward curvature of the glans penis and an associated fibrosis of the corpus spongiosum. The external urethral meatus may be atresic. The urinary sphincters are never involved. Phimosis

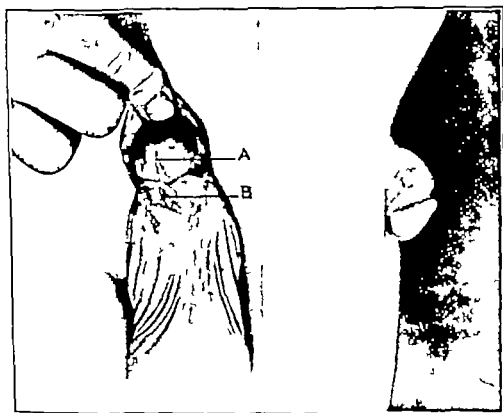


FIG. 73.—A. Urinary meatus in normal position. B. Phimosis.

never exists in hypospadias and circumcision except for the use of the foreskin in the reconstruction of the urethra is never indicated, is always contraindicated and should never be done. There may be dimpling in the region of the normal urinary meatus or blind opening here and in connection with discussing this malformation it is interesting to note that there are cases where the external urinary meatus is in normal position but all the other deformities usually associated with hypospadias are present, namely, hooded foreskin and contracted corpus spongiosum with downward curvature of the penis (Fig. 73). In one such case a surgeon had nicked the urethra in an attempt to free the penis which had produced a urethral fistula. A circumcision

had also been done At the point where the urethra had been nicked I divided the urethra completely and preserved the glandular portion



FIG 74 —One month postoperative

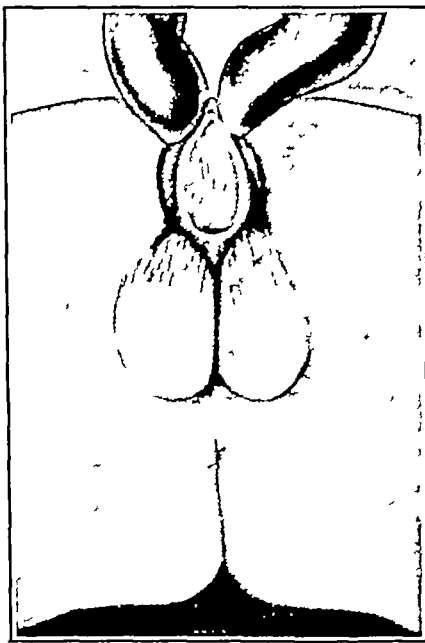


FIG 75 —Penoserotol hypospadias with bifid scrotum

By dissecting back the proximal portion of the urethra and dividing hindering bands and dissecting out the fibrous corpus spongiosum it was possible to straighten the penis as shown in Fig 74 I have not

yet undertaken the urethroplasty but will use for this either a Thiersch or a modified Bucknall operation

It is customary to characterize the varying degrees of hypospadias as glandular penile penoserotral scrotal perineal and as forms of pseudohermaphroditism

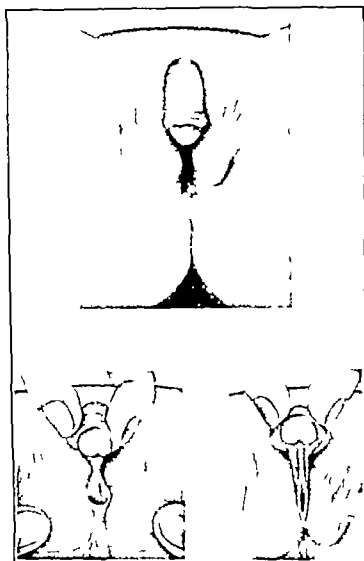


FIG. 76.—Scrotal hypospadias.

In glandular hypospadias the deformity of the penis may be very slight. As the external urinary meatus moves backward the deformity increases consisting of more and more shortening of the corpus spongiosum and downward curvature of the penis. In scrotal and perineal hypospadias the scrotum may be cleft or almost absent the testicles may be smaller than normal or undescended. In pseudohermaphroditic hypospadias the sex may be very questionable the penis bound down and very small. On the contrary the subject may be a female

in which the clitoris is so hypertrophied as to be equally deceiving (Fig 77)

Many operations have been devised for the treatment of minor degrees of hypospadias and, in fact, some of the earliest operations done were instituted for this purpose. The only reason for operating on any hypospadiac patient is to correct deformities which interfere with the functions of urination or procreation. To these some surgeons have added the additional consideration of operating on minor degrees of hypospadias because of mental disturbances which have arisen in regard to this defect. I think that we can very definitely reach the conclusion that no operation should be carried out in childhood for the correction of minor degrees of hypospadias, for not only am I

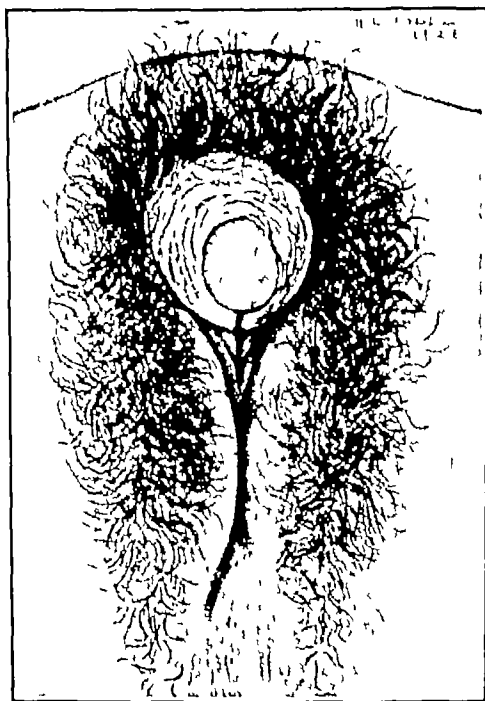


Fig 77 —Female, aged nine years Hypertrophy of the clitoris Retention of urogenital sinus

convinced that such operations are not justifiable, but to do so would require, in certain instances, diversion of the urinary stream which is likely to be associated with a cystitis and pyelonephritis. Now it is true that we subject children to these hazards in the treatment of more marked deformities, but there it is justifiable. The best that can be said for any attempt to treat minor degrees of hypospadias is that it is an operation for an adult to decide upon and for the surgeon to refuse to do. There is always a possibility of failure in which event the hypospadiac opening is likely to be farther back than it formerly was. The surgeon becomes involved in a series of operations, the net result of which is likely to leave the patient in a worse condition than he formerly was.

In 1837 J. L. Pettit² in dissecting the genital organs of a child aged twelve years whom he had examined during life and who had penoscrotal hypospadias with deformity inflated the corpora cavernosa and then separated the urethra from the corpora cavernosa. He found that the penis still kept its deformity and he attributed this to a fibrous band beneath the penis but even the division of this band did not straighten the penis. In making a study of the cells of the corpora cavernosa Pettit found that there was an atrophy of these cells on the concave portion. He did not know whether they had always been in this condition or whether this atrophy was secondary to the hindering bands beneath the penis. Bouisson¹ also insisted upon the participation of the corpora cavernosa in the malformation and noted the arrest of development of the corpora cavernosa on the under surface where the urethra is lacking. Duplay showed that the intracavernous septum played a part in the deformity. Clinical experience would seem however to bear out the statement that if the skin, subcutaneous tissues and fibrous bands are divided and if the fibrous band extending up between the corpora cavernosa is dissected out sufficiently early in life that the corpora cavernosa will fully develop. It should be noted however that the autopsy report of Pettit was made on a child of only twelve years of age and this brings out the very practical point that the operation for the correction of the deformity in hypospadias should be carried out very early in life in order that the corpora cavernosa may fully develop. I can recall but one or two authors who have suggested that this operation be done within the first two years of life and yet I am convinced that it is at this time that the operation should be done. The operation for the correction of the deformity should be done as soon as the child has been weaned and its nutrition has been fully established. Obstetricians and pediatricians should be thoroughly familiar with this subject.

Credit is usually given to Bouisson for originating the operation for correcting the deformity of the penis in hypospadias. Bouisson's work was published in 1860. It is of interest to American surgeons to know that Dr. J. B. Mettauer³ of Prince Edward County, Virginia, writing in 1842 on hypospadias first described a method for the subcutaneous division of the fibrous bands antedating Bouisson's work by eighteen years. It was Duplay who first used the procedure of the open transverse incision and closing the wound longitudinally and this is the most satisfactory method and the method which is almost universally used today.

The transverse incision should divide Buck's fascia and all constricting fibrous bands of the intracavernous septum. Some authors have suggested that in some instances it is wise to cut into the corpora cavernosa. It seems to me that this is a bad procedure on account of hemorrhage. Many times it is advisable to dissect out longitudinally the entire fibrous band representing the remnants of the corpus spongiosum between the cavernous bodies. The essential thing is that an absolute correction of the deformity must be made. In doing the

operation for the correction of the deformity the urethra, of course, will be shoved very much farther backward (Fig 78) Beck¹⁷ has suggested that at the time of making the transverse incision that the lozenge-shaped defect should be covered by the foreskin which is

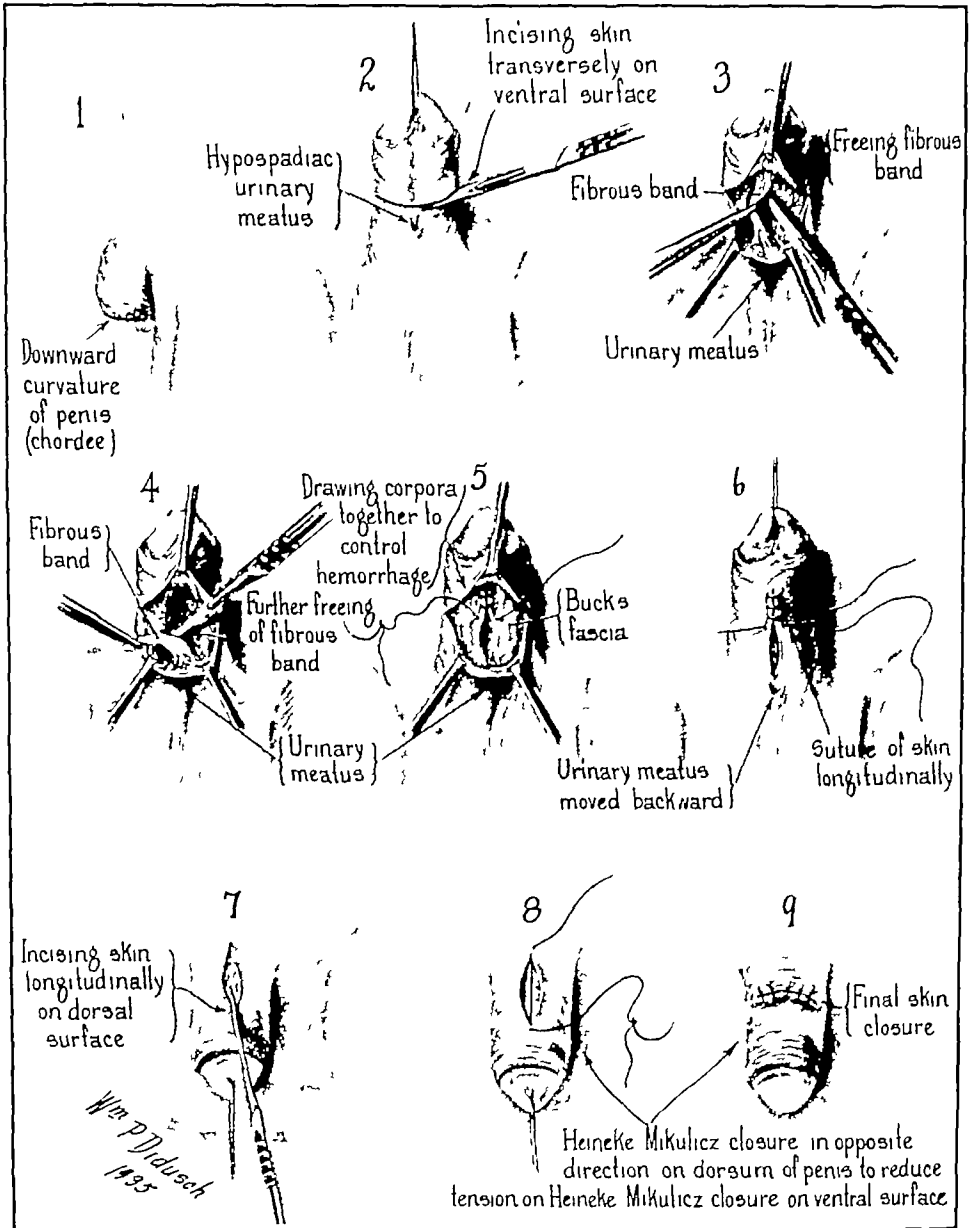


FIG 78 —Correction of downward curvature in hypospadias

buttonholed, and the penis passed through the foreskin, thus giving a skin graft covering to the under surface of the penis, and at the same time placing the redundant foreskin there for future work in reconstruction Cabot,²⁶ following the work of Edmunds,²⁷ more recently has done a preliminary operation of buttonholing the foreskin and

then suturing the edges around as a buttonhole is sewed. After the wound has healed and when it is decided to correct the downward curvature of the penis the fibrous bands are dissected out on the ventral surface and the defect is covered by dividing the buttonholed foreskin and splitting it up on its most dorsal surface thus fresh edge pedicle grafts are available for covering the defect on the ventral surface of the penis.

Pousson²⁸ has called attention to the fact that the glans deformity in connection with the shaft of the penis is in addition to the elbowing or curvature of the penis on the scrotum and points out that severing of the tissues beneath the penis cannot correct the malposition of the glans. He recommended as an operation for the correction of the glandular deformity that the glans be separated from the two cavernous cylinders by incision that a triangular piece be cut out on the dorsum penis, and that the tissues then be sutured. He recommended that this operation be done after the one for the correction of the downward curvature. Pousson states that as a result of this procedure that the glans at first is flabby, withered and without sensation but soon becomes normal. At best this operation creates a bad condition on the dorsum of the penis to counteract a similar one on the ventral surface. I do not believe that there is any justification whatsoever for this operation.

Reconstruction of the Urethra — Early in the consideration of the treatment of hypospadias appeared the idea that heteroplastic grafts (zoögrafts) might be used for this purpose. It is now known that such grafts are biologically incompatible and while they might form a sort of scaffolding in some instances in view of the questionable nature of homoplastic grafts I think that one would be reaching far out into a very experimental field to attempt to reconstruct the urethra by any type of animal graft. In view of the ease with which other material may be obtained there would seem to be no justification for attempting to do heteroplastic grafting.

There is considerable difference in opinion as to the advisability of utilizing isografts and even as to whether such grafts will persist. It is possible that the success or failure of such grafts is somewhat dependent upon the similarity or dissimilarity of blood groups of the host and donor. Masson²⁹ at the Mayo Clinic reported excellent results with isografts in skin grafting, but never had a successful result in which the red blood corpuscles were agglutinated by the serum of the patient. Shawan³⁰ has confirmed these findings. Irrespective of the use of skin of one individual which may be transplanted to another the attempts at isografting for the reconstruction of the urethra are disappointing. Schmieden³¹ reported 3 cases in which he attempted to transplant the ureter the result of which operation seems to show that it might be possible to transplant a ureter from another individual. The results obtained by Schmieden in attempting to do so were not very satisfactory. One case was a complete failure one case required a great deal of dilatation and in one case the patient disappeared

before the two canals had been united. One might in this connection mention the work of Legueu³² to reconstruct by means of vaginal mucosa, war injuries of the urethra. Apparently the urethral canal was established but the cases required prolonged dilatation and it is questionable as to what part the vaginal mucosa played in the formation of the canal.

The use of the appendix was first suggested by Lexer in 1911,³³ and since then has been used by Streissler,³⁴ Weitz,³⁵ Rosser³⁶ and McGuire.³⁷ McGuire apparently got satisfactory results in 3 patients in whom he reconstructed the urethra from the appendix. It is not quite clear from his article as to whether all of these cases were isografts, but one of them definitely was so and a satisfactory result was obtained. That McGuire believed that isograft material would be satisfactory is shown by the fact that he suggested that in reconstructing longer portions of the urethra two appendices might be sutured end to end. Blair,³⁸ in discussing McGuire's work, stated that he was very much surprised at the results secured as it was his experience that no graft would grow from one individual to another. McGuire thought that the graft might possibly have acted as a scaffolding and might not have grown as a true graft. Axhausen,³⁹ in an article on the prognosis of transplantation of the appendix in hypospadias, discusses the subject from an experimental and clinical standpoint. He quotes the work of Weitz who reported 2 cases, but Axhausen thought that inasmuch as these cases were reported one only two months and one only four months after operation that it was too early to know what might subsequently happen to these grafts. Apparently when they were reported, the canal was established, but Axhausen states that the appearance of the mucous-membrane-like lining does not necessarily mean that this is the case and that unless the mucosa persists that sooner or later granulated tissues will cause obliteration of the canal.

He states that a urethral tube may be very deceiving and that epithelial lining may persist for a considerable length of time, only to be ultimately obliterated. In experimental work on animals he found that appendix mucosa would grow only in one situation, namely, when it was fed by the omentum. Axhausen reports 2 cases in which he transplanted the appendix mucosa both in four-year-old boys. Serosa and muscularis were removed according to the method of Lexer. Healing took place smoothly and after three weeks apparently the urethra had been restored. When the time came for anastomosing the new urethra with the old, histological studies showed that there was no trace of epithelium left in spite of the fact that the urethra gave every impression that it had remained alive and was lined with mucous membrane. The walls consisted of smooth musculature which was partly necrotic and for the rest of connective tissue. The patient remained well for three or four months by the use of a bougie, but later the material had to be removed and at this time serial sections showed no trace of epithelium whatsoever. As other isograft material

one might consider the foreskin of an adult of the same blood grouping. As I shall show later the difficulties attending free autoplasmic grafts are very great and there is no lack of material in the individual himself so that while it might be possible to bring about a reconstruction of the urethra occasionally by the use of isografts, it seems to me to be doubtful judgment to attempt to do so.

I shall now discuss autoplasmic free grafts. Trout⁴⁶ of Roanoke Virginia has reported the use of the appendix for this purpose with a satisfactory result. Again one must refer to the experimental and clinical observations of Axhausen. Fanton⁴⁷ used a vein as has Tuffier⁴⁸ Marion⁴⁹ Patel and Lerche⁵⁰ Unger⁵¹ Beck⁵² and others. It would seem that such free venous grafts might occasionally take. Still careful reading of the different reports shows nearly always the existence of a fistula and in many instances partial or complete elimination of the graft. Fanton and Lerche believe this elimination was due to infection. Cantas⁵³ regarded the elimination as due to the lowered vitality of the transplanted vein and for this reason suggested the use of the saphenous vein leaving one end attached and using a piece of overlying skin as an additional supply for nourishment a pedicle vein skin graft.

One of the greatest exponents of autoplasmic free grafts was Nové-Josserand⁵⁴ who in 1897 promulgated a new method for the treatment of hypospadias. He conceived the idea of making a dermo-epidermal tube from the skin of the outer side of the thigh and to introduce this tube beneath the skin of the penis which had previously been tunnelled and then by various methods of dilatation he hoped to epithelialize the newly made tunnel. I have reviewed all of Nové-Josserand's work in detail. Fistulae were common many times due to an infected clot which formed along the tunnel as I have mentioned above. There was a tremendous tendency toward total obliteration of the canal and in practically all cases a marked tendency toward shrinkage both in length and in diameter requiring internal urethrotomy which in many instances had to be repeated prolonged dilatations and new attempts to epithelialize strictured portions. Altogether I am sure that the procedure is a very unsatisfactory one for the reconstruction of the urethra. Did one not read Nové-Josserand's article for 1914⁵⁵ in which he relates his cases in detail one might get an entirely erroneous impression from some of the other articles but this is reasonable for nothing but a tremendous believer in his own method could have kept this operator at work tunnelling for twenty three years in spite of innumerable failures.

I have attempted Nové-Josserand's operation only once. For a time the graft seemed to take but it ultimately entirely disappeared so that there was no trace left. Infection did not take place nor was the graft extruded. It seemed to be absorbed or gradually eliminated. It was possible that something resembling a urethral canal could have been preserved by prolonged dilatation internal urethrotomy and

so on, but it did not seem to me that such procedures should form a necessary part to the construction of an urethral canal

Before taking up a consideration of pedicle grafts for the reconstruction of the urethra, I should like to say something in regard to the work of Beck,⁴⁶ whose operation stands quite apart Beck, like Nové-Josserand, devoted many years of his life to the reconstruction of congenital defects of the urethra He is best known for his advancement of the urethra operation Beck's idea was that inasmuch as the urethra was extensible during erection that there was no reason why it should not be stretched out at any time and thus supply the urethral canal He first began by using this method only in very minor cases, but eventually used it in much greater degrees of penile hypospadias Writers differ as to the value of this operation In some instances retraction took place and it was not uncommon for the urethra which had been passed through the glans to slough away, or to break away, from its moorings and fistula to result In addition to this it was sometimes associated with rigidity about the urethra which was unbearable

Pedicle Grafts—I shall now discuss pedicle grafts and it is in this group that we must unquestionably look for the operations that will successfully cure hypospadias I think it is well for one to determine at the outset whether one considers it advisable to attempt to make a glandular portion of the urethra It is my opinion that this gives some added difficulty to what is already a fairly difficult undertaking, and if the urethral canal is constructed to open in the region of the frenum well forward that this is probably the most normal position that the external urethral orifice could occupy The glans is always turned downward even though the incurvation has been cured, and it would seem that this type of opening would be likely to be more normal than projecting the urethra upward through the glans

The decision upon this point would rule in or rule out most of the operations in which a tubular pedicle graft is constructed from the foreskin Mayo⁴⁸ very successfully used the foreskin in the construction of the urethra in minor degrees of penile hypospadias, and in combination with Thiersch's operation for the reconstruction of longer portions of the urethra Russell's⁴⁹ operation, which at first sight appears unique, is really nothing more than Duplay's operation as far as the construction of the penile urethra is concerned to which is added a hood of the foreskin in continuity with the penile flaps, this portion of the graft being used for the development of the glandular portion of the urethra Donnet's⁵⁰ operation is much the same as Mayo's operation except the tubular foreskin graft is introduced from the side rather than over the dorsum of the penis I have used the foreskin for the reconstruction of a portion of the penile urethra in perineal hypospadias and there is no question that pedicle grafts derived from the foreskin will almost invariably take and that they will maintain their caliber They do, however, have a tendency toward contraction in length This may be relative and due to lack

of participation in the growth of the penis. Young¹ constructs the glandular portion of the urethra from the foreskin by a graft taken from a lateral aspect of the penis thus avoiding anastomosis between the urethra constructed from the foreskin and the old urethra. Bevan³¹ operation consisted in raising a flap from the shaft of the penis in minor degrees of penile hypospadias in somewhat the same way that Rochet's³² operation is done in turning up a tubular graft from the scrotum in more marked degrees of hypospadias. I believe that Bevan's operation has much to recommend it. This operation and the Ombredanne operation have many points in common. There are various combinations of operations of narrow base pedicle grafts such as the operation of Beck¹⁷ in which the urethral canal is formed after the first method of Duplay and then the raw surface covered by a narrow pedicle graft twisted on itself turned up from the scrotum. Of a somewhat similar nature is the method of Crabtree in which the roof of the canal is formed from the skin of the penis which is left attached. The floor of the canal is formed by a long pedicle graft from the scrotum and the raw surfaces are covered by lateral flaps from the penis.

Cantas⁴⁷ introduced a method of turning up a pedicle graft of the saphenous vein with the overlying skin. There are many objections to this method among others being that the vein may not have sufficient caliber or it may be divided.

There is no question in my mind but that the most logical and satisfactory method of reconstructing a urethra in hypospadias is founded upon the principle that the flaps should be of broad base that they should be constructed from the penis itself in order that there might be no retraction in length and that the roof of the canal should be left entirely attached along the surface of the penis thus assuring the absolute absence of decrease in diameter and that the canal will develop with the development of the penis. It is important to avoid anastomosis if possible for at the points of anastomosis fistula and stricture are likely to occur. Anger¹² in 1874 was the first to apply these principles. He adapted the operation which had been devised by Thiersch for the treatment of epispadias to the treatment of a case of penoscrotal hypospadias. Anger secured a perfect result and this was the first case in which hypospadias had been cured by any method. Duplay's method of raising lateral flaps from the surface of the penis embodies some of these principles but the operation has a tendency to leave fistulae. Duplay recognized this and subsequently changed his technique so that more tissues might be had for the bringing together of broad surfaces at the external point of suture. He did this by making an incomplete inner tube which was not sutured and then bringing together the outer tube and utilizing the tissues which he had formerly used in the making of the inner tube to assure a broad apposition of flat surface which were held together by silver wire and leaded quilled sutures.

Thiersch's operation has a distinct advantage over Duplay's, in

that the approximation of the skin edges are not in juxtaposition. It has other advantages than this, in that the broad surfaces bear on one another, and that there is a counterbalance so that one flap in contracting tends to pull the other flap in position and *vice versa*. A very beautiful example of the cure of a marked degree of perineal hypospadias was reported by Hagner in 1922⁵³. Cabot, Walters and Counseller²⁶ have recently reported from the Mayo Clinic 26 cases operated on by this method.

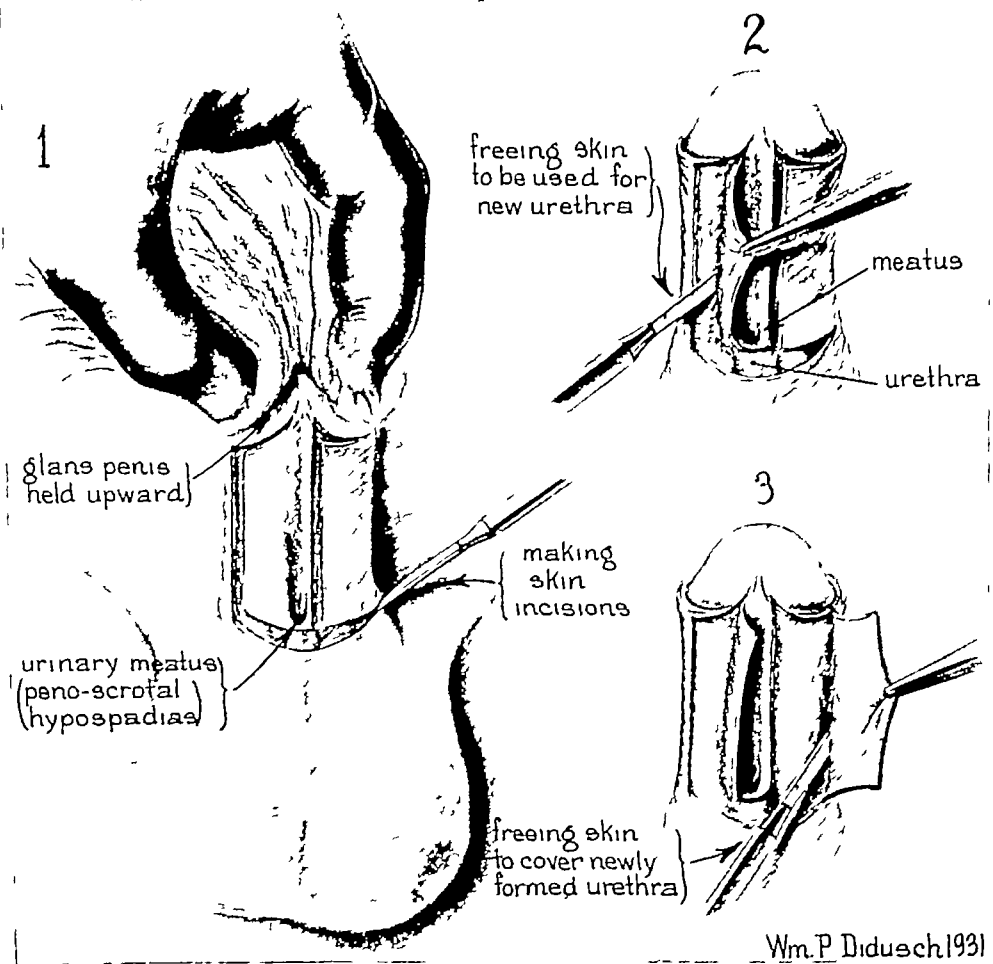


FIG. 79 —Adaptation of Thiersch's method for reconstructing the urethra in penile hypospadias. Posterior skin flap has been dissected back.

In the earlier use of the Duplay and Thiersch methods of reconstructing the urethra the tubes were first made and later anastomosed. This is not advisable in penile or penoscrotal hypospadias as in these cases the entire operation can be done in one procedure, not only to make the urethra but to make the anastomosis. The flaps should be freely dissected up to about one-half the way around the penis in order that some of the redundant skin on the dorsum of the penis

might be brought into use to avoid tension. I do not believe it is advisable to use stay sutures from the inner constructed tube that pass through the outer skin as this tends to make sinus formation where these sutures pass through. Without these sutures, however

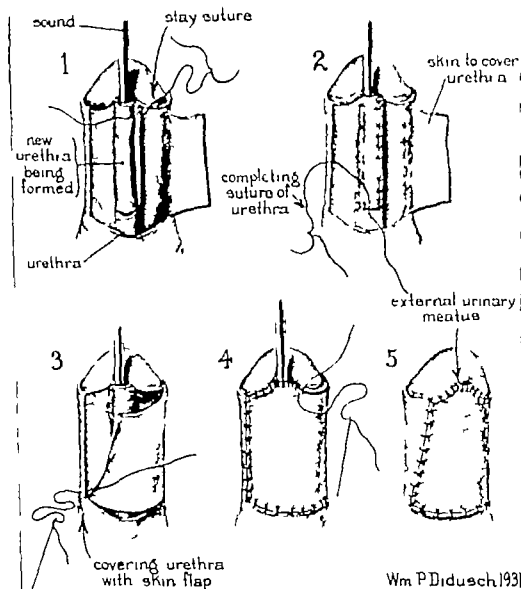


FIG. 80.—Note that the anastomosing of the new and old urethra carries out the same principle as the lateral anastomosis. By dissecting back the skin over the urethra posteriorly the urethral and overlying skin sutures are not in juxtaposition. This procedure avoids sinuses and saves one step in the operation as originally done by Thieme.

the penis will assume a twisted appearance at the completion of the flap operation. This should give no concern as experience has shown that the penis will assume a normal shape and that rotation will disappear in about two months.

The same principles of not having overlying lines of sutures in juxtaposition should be used in making the anastomosis between the new tube and the old. This is easily brought about by dissecting back the posterior flap. The steps of this operation for penile and penoscrotal hypospadias are shown in Fig 80.

Figs 81 and 82 show the results obtained in using Thiersch's operation in a boy aged seventeen years with penoscrotal hypospadias. The right testicle in this case had been brought down at the age of twelve and the deformity of the penis corrected at the age of thirteen years. This boy was cured in one operation. No sinuses occurred.



FIG 81 —Result of Thiersch operation for penoscrotal hypospadias



FIG 82 —Urinary stream is large size and good force

and at no time has there been any tendency toward stricture. The boy voids urine in a large-sized stream with normal force.

In perineal hypospadias the method of Thiersch is also in my opinion the best method. Here the perineal outlet is utilized for the passage of urine during the construction of the urethra down to within 1 cm. of this opening. Having constructed a satisfactory urethra down to the perineal outlet a suprapubic drainage is now done and the perineal opening closed by the method of Duplay (Figs 83, 84 and 85). This is extremely easy because there is considerable tissue depth at this point. Figs 86, 87 and 88 show a case of perineal hypospadias.

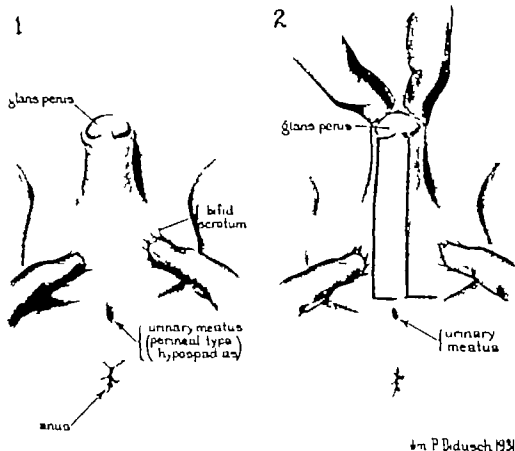


FIG. 83 — Skin in skin for perineal hypospadias.

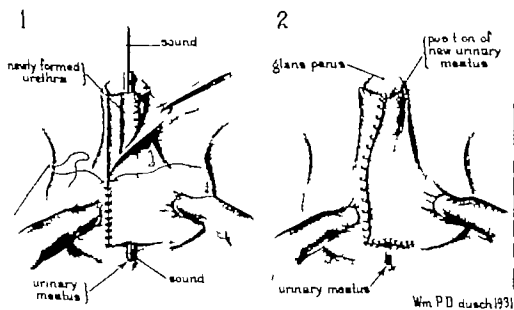


FIG. 84 — Adaptation of Thiersch's method for reconstructing the urethra in perineal hypospadias.

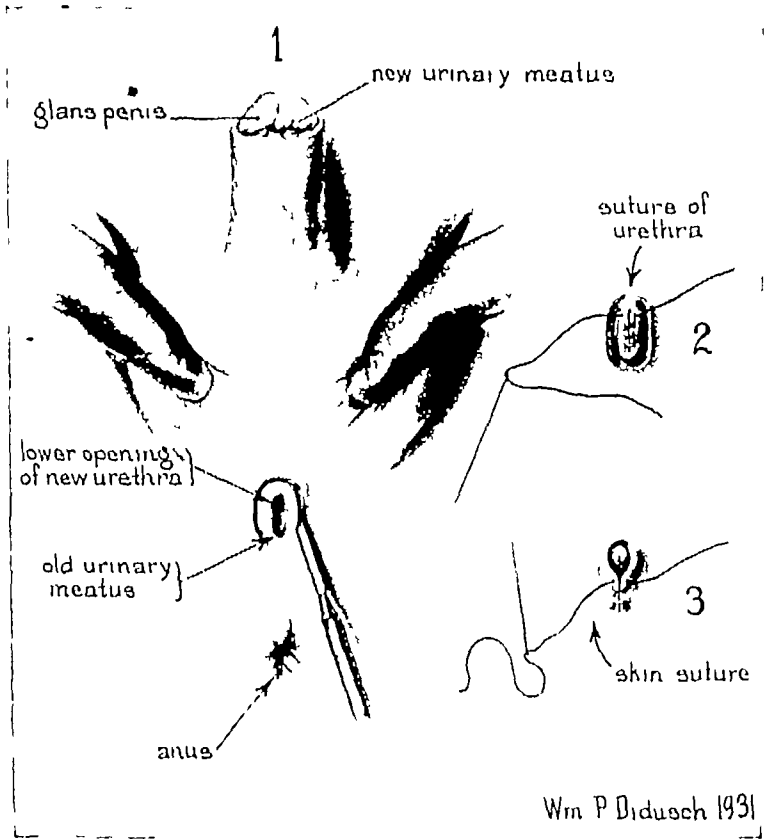


FIG 85 —Method of closing perineal wound after penoperineal urethra has been constructed At this stage suprapubic drainage and suction apparatus is advisable

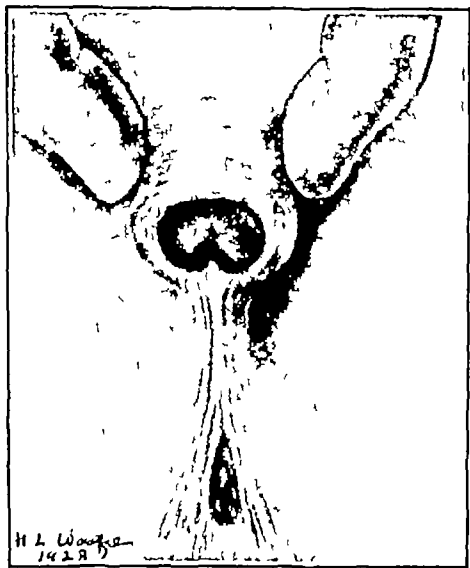


FIG 86 —Opening of the hypospadiac urethra was very short distance in front of rectum Scarcely any scrotum Both testicles in abdomen

in which the patient was cured by the Thiersch method. Healing took place *per primum* throughout. No sinuses occurred at any time nor were there any strictures.



FIG. 87



FIG. 88

Figs. 87 and 88 —Result of combination of foreskin graft and Thiersch operation in perineal hypospadias.

In addition to Thiersch's operation other operations of proven value are the operation of Bucknall,²⁰ first described in 1907, the operation of Ombrédanne¹⁹ in 1911 and various operations involving the principles of the pedicle flap, these flaps being taken from more or less distant regions and manipulated at various stages of the procedure so as to construct a urethra. This latter method, according to Cabot, Walters and Counseller, has been carried out with great skill by Blair⁵⁴ and others. They state that they have had no personal experience with these methods and it is their belief that it will find the greatest usefulness in the hands of those who are thoroughly familiar with the formation and management of pedicle flaps.

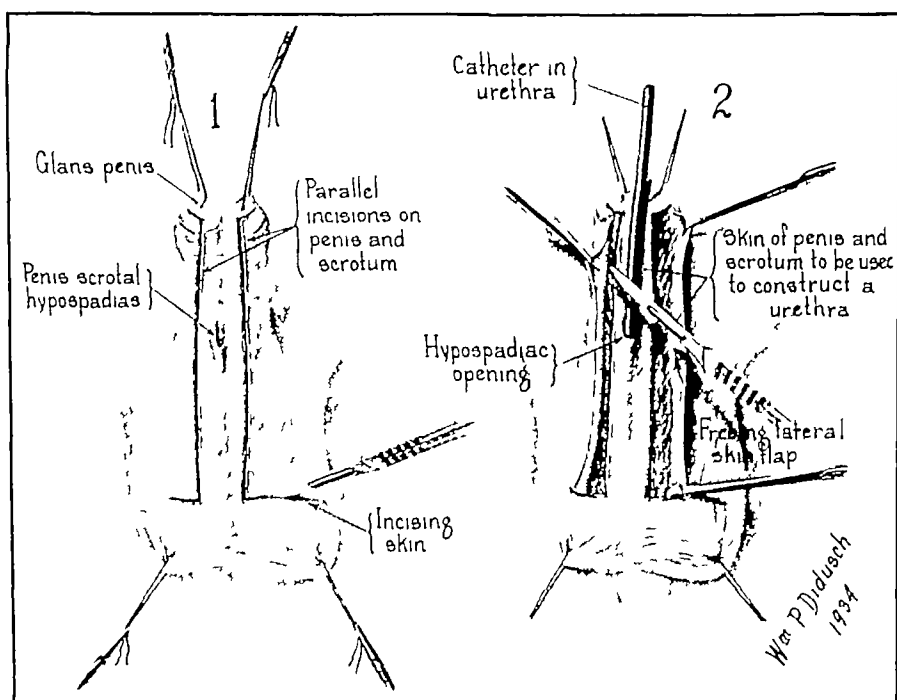


FIG 89

Bucknall's operation consists in forming a floor for the urethra from the scrotal skin by means of suturing freshened lateral flaps on the penis down to similar freshened lateral flaps on the scrotum (Figs 89 and 90). No operation is done for the diversion of the urinary stream, but a retention catheter is put in, the scrotum and penis behind held upon the abdomen to avoid kinking of the catheter and pressure by the catheter on the urethra at the penoscrotal junction. Healing having occurred, the urethra is then dissected off from the scrotum by a wide flap which is brought together to cover the raw surfaces on the penis. The raw surface on the scrotum is then covered by bringing the skin together from side to side (Fig 91). Bucknall reported three successful cures by means of this operation. Churchman²² and Harvey⁵⁵ have also reported satisfactory results by the use of the

method Harvey adapted the method to cases that were not of the penoscrotal type. Bucknall recognized that there might be two drawbacks to this operation. First that the operation was applicable only if the scrotum is unclift and second the possibility of hair growing in the urethra. He recommended that the skin strip on the penis should be wide and that the scrotal strip should be narrow so as to include little more than the raphe which seldom has any hair on it. He also thought that if the operation were done early in life that

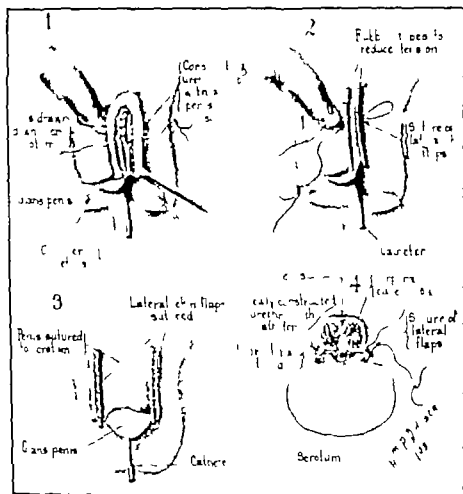


FIG. 100

the character of the lining of the tube might be altered and that hair might not develop. That this complication may occur is shown by the case reported by Vermeulen²⁴ in which a hair tumor was removed from the urethra following Bucknall's operation. Cabot²⁵ has also had a stone form in the urethra following Bucknall's operation and states that this was the operation of election in his hands for more than ten years but that he has abandoned the procedure because of the unavoidable possibility of hair growing within the urethra. It has occurred to me that the difficulty of hair growing in the urethra

In addition to Thiersch's operation other operations of proven value are the operation of Bucknall,²⁰ first described in 1907, the operation of Ombrédanne¹⁹ in 1911 and various operations involving the principles of the pedicle flap, these flaps being taken from more or less distant regions and manipulated at various stages of the procedure so as to construct a urethra. This latter method, according to Cabot, Walters and Counseller, has been carried out with great skill by Blair⁵⁴ and others. They state that they have had no personal experience with these methods and it is their belief that it will find the greatest usefulness in the hands of those who are thoroughly familiar with the formation and management of pedicle flaps.

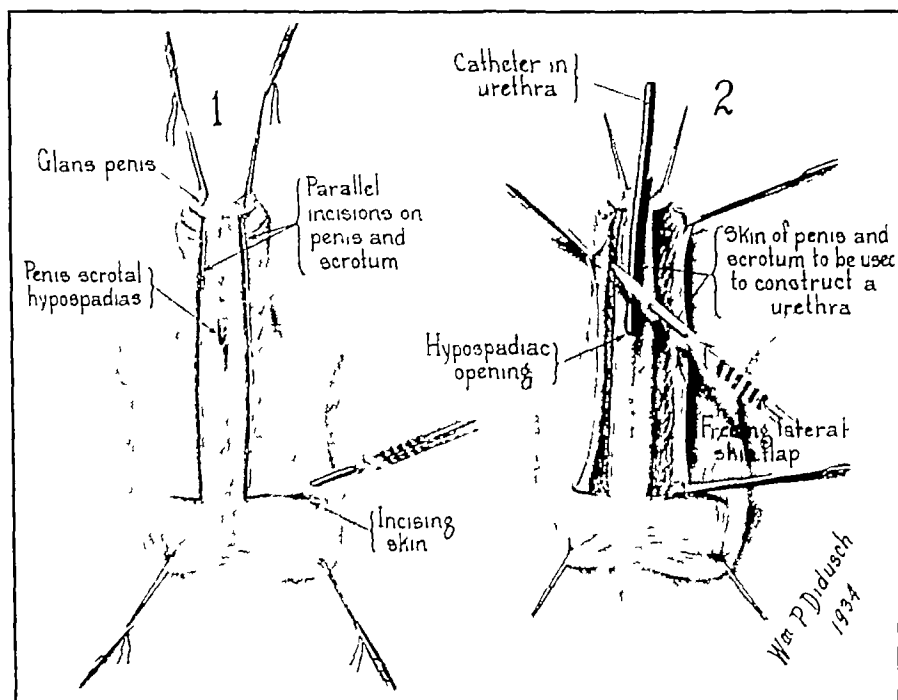


FIG 89

Bucknall's operation consists in forming a floor for the urethra from the scrotal skin by means of suturing freshened lateral flaps on the penis down to similar freshened lateral flaps on the scrotum (Figs 89 and 90). No operation is done for the diversion of the urinary stream, but a retention catheter is put in, the scrotum and penis behind held upon the abdomen to avoid kinking of the catheter and pressure by the catheter on the urethra at the penoscrotal junction. Healing having occurred, the urethra is then dissected off from the scrotum by a wide flap which is brought together to cover the raw surfaces on the penis. The raw surface on the scrotum is then covered by bringing the skin together from side to side (Fig 91). Bucknall reported three successful cures by means of this operation. Churchman²² and Harvey⁵⁵ have also reported satisfactory results by the use of the

vary. Having turned up a pouch from the penis the raw surface beneath the glans is covered by a pierced foreskin which has previously been opened out by dissection. A part of the raw surface on the shaft of the penis is covered by lateral flaps (Fig 91). There is thus produced beneath the glans a redundancy which Ombredanne called the 'tubercle'. A period of approximately four months is now allowed

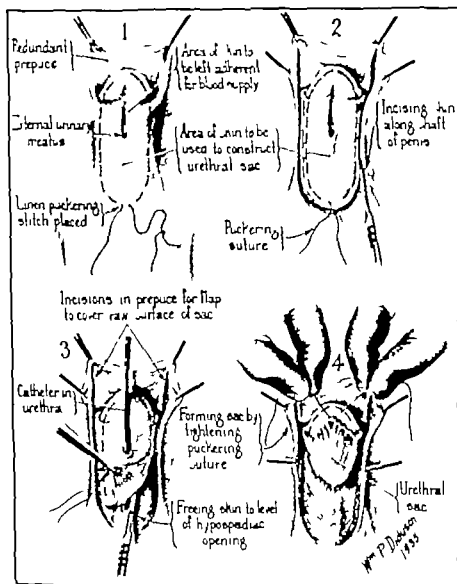


FIG 90

to pass when the glandular portion of the urethra is formed by uniting the tubercle with the glans the internal layer of sutures being brought out through the meatus and knotted (Fig 95). In extreme degrees of hypospadias the sac is advanced in two stages thus a perineal meatus becomes a penile meatus (Fig 93) but Ombredanne has warned against trying to advance the sac too rapidly and has in some instances

could be avoided by making the entire tube from the skin of the penis after the method of Duplay, rather than from any part of the scrotum, the raw surface of the penis then being approximated to a raw surface of the scrotum and lateral flaps sutured to lateral flaps on the scrotum as in Bucknall's operation. Bucknall very closely approached this method when he recommended that the scrotal strip be very narrow. It is not necessary to have a scrotal strip in the formation of the

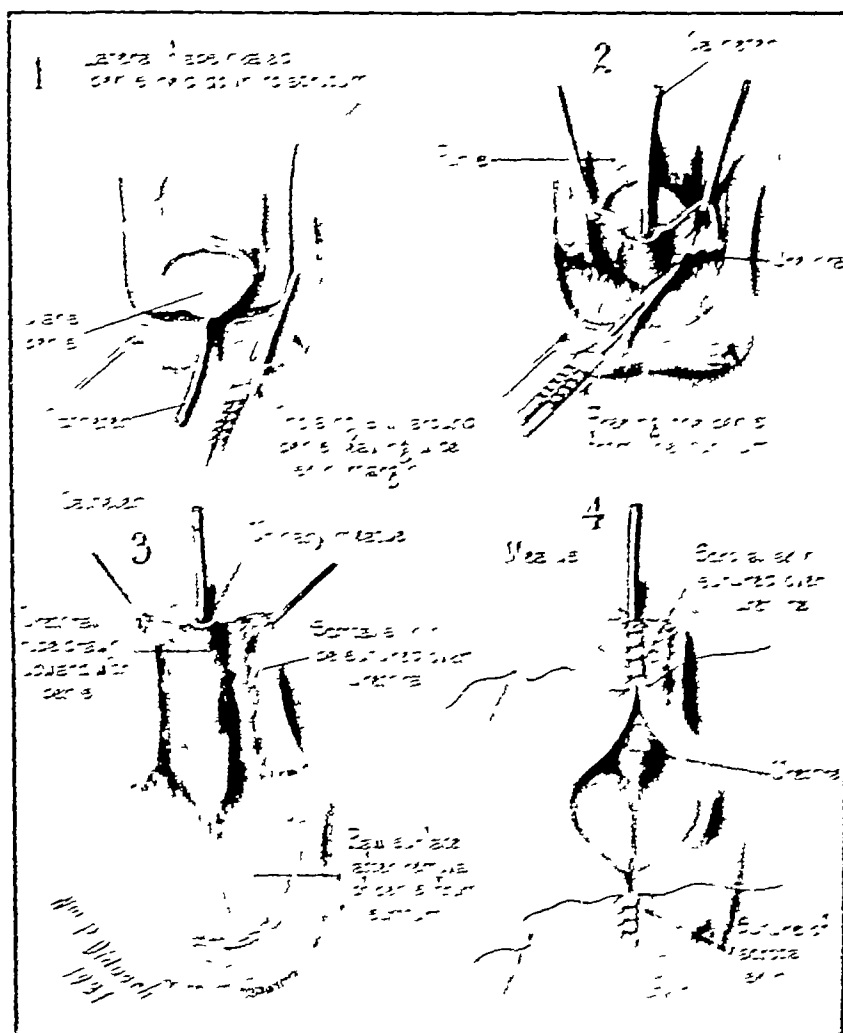


FIG. 91

urethra to gain the principal advantage of Bucknall's operation which is brought about by the use of broad lateral flaps, thus avoiding fistula.

Ombredanne's operation consists in turning up a flap of skin from the penis or in successive stages from the scrotum and penis in the form of a pouch (Figs. 92 and 93) so that there is no possibility of leakage and therefore, no diversion of the urinary stream is neces-

has operated on 392 cases. Lyle advocates this method as does Walters² of the Mayo Clinic (Figs. 96 and 97). Both of these operators have considerable series of successful cases to warrant their belief in the value of this operation.

One must have various operations at one's command to be able to deal with the different situations that may be found in hypospadias. For instance it is evident that Bucknall's operation cannot be done for perineal hypospadias. It cannot be done in cases of bilateral

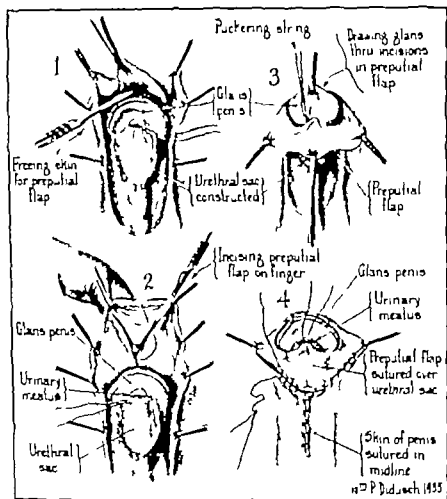


FIG. 94

abdominal cryptorchidism where the scrotum is absent. So too many cases unfortunately have been circumcised by some unwitting surgeon and in these cases it is evidently impossible to do the classical Ombrédanne operation. On the other hand where Thiersch's operation has been unsuccessful it would be bad judgment to attempt to repeat it and in such a situation a Bucknall's operation or some modification of it might well be curative.

Epispadias.—This condition is characterized by an abnormal opening of the urethra on the dorsal surface of the penis. If of any consider

used three stages. Then the classical operation is done as mentioned above. Later the lateral ears are excised, being careful to avoid cutting into or placing sutures in a possible lateral extension of the pouch (Fig 95).⁵ At the original operation care must be taken to excise the roots of any hairs and, before the glandular portion of the

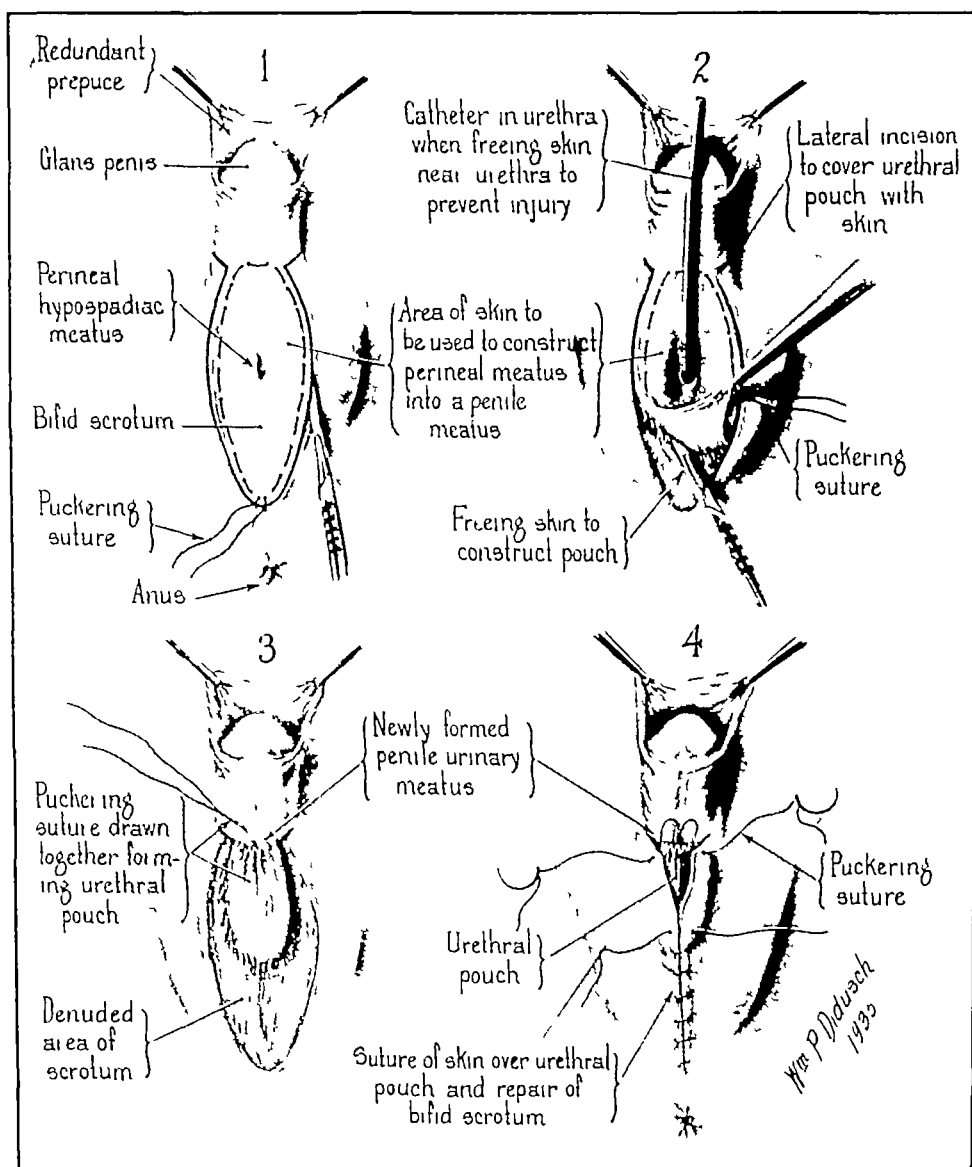


FIG 93

urethra is built, a careful inspection of the urethra should be made. If hairs are found, Lyle⁵⁷ recommends that the skin bearing the hairs should be excised with curved scissors and, if necessary, the whole cutaneous area of the inferior surface may be excised without fear of retraction as there is sufficient mucosa on the roof of the canal to furnish a complete covering. By means of this procedure Ombrédanne

able degree there is an associated deformity of an upward or dorsal curvature of the penis and a spreading apart of the corpora cavernosa.

In contradistinction to hypospadias the penis in these cases is likely to be larger than normal. The testicles as a rule are within the scrotum. The degrees of epispadias are characterized as glandular penile and

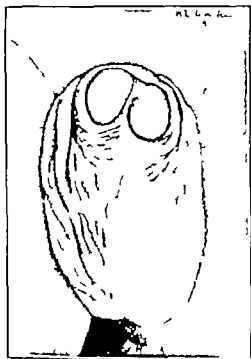


FIG. 98

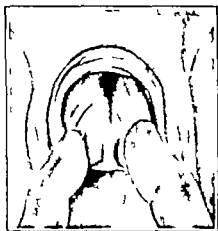


FIG. 99

FIGS. 98 and 99 — Penile epispadias.

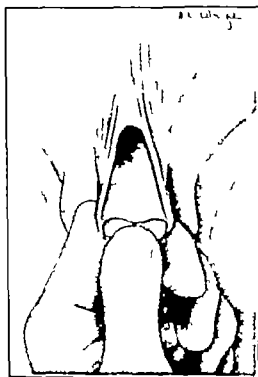


FIG. 100 — Complete epispadias.

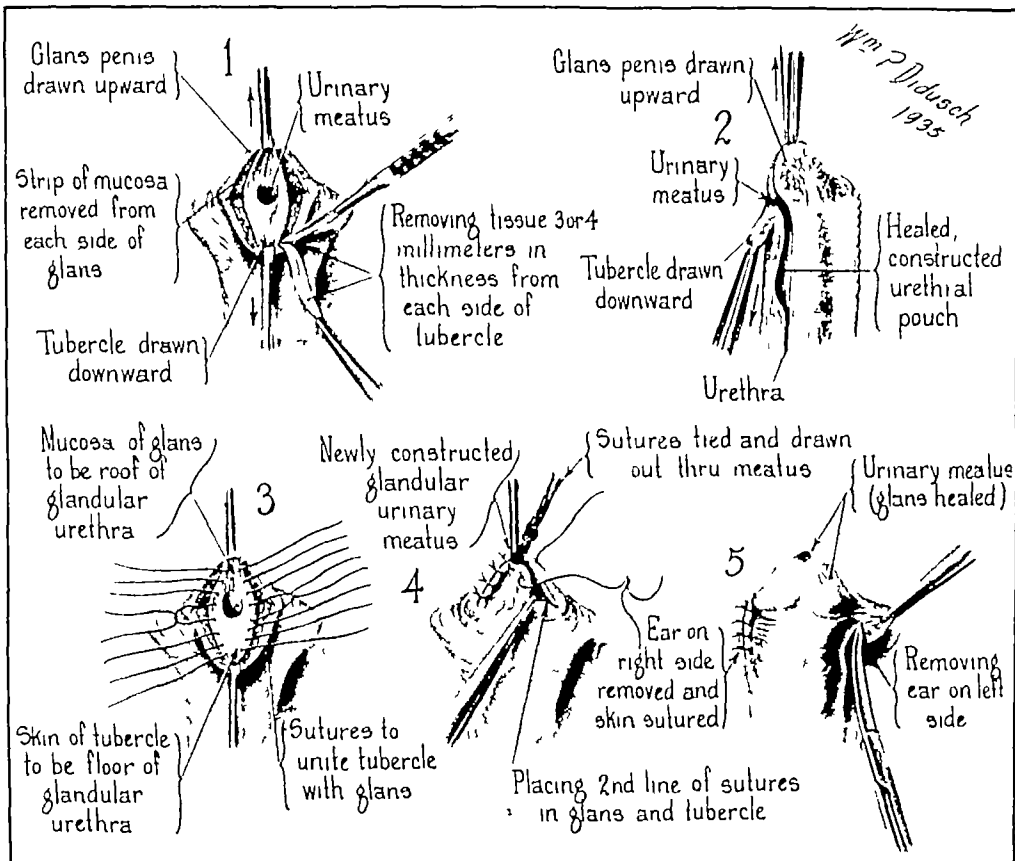


FIG 95



FIG 96



FIG 97

Figs 96 and 97 —Result of Ombrédanne's operation for perineal hypospadias. This case also presented bilateral cryptorchidism which was operated by the Torek technique (Walters)

condition by a mechanical device in which pressure was brought to bear on the roof of the penis.

It is of interest to note that Duplay¹³ writing in 1880 stated that it was his belief that the incontinence of urine was due to a defect in the constrictor muscle at the neck of the bladder and that this might be cured by operation. Previous to Duplay's time it was not recog-

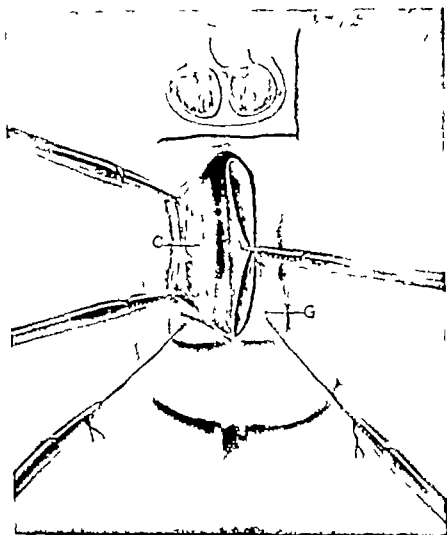


FIG. 10⁹—The separation of the two corpora has been completed. The skin edge is being retracted to the right and the edge of the new urethra to the left exposing the right corpus (C) and exposing also the space between the two corpora, the floor of which is formed by the inner surface of the skin of the under surface of the penis. The relations are clearly indicated in the cross-section. (Young.)

nized that there was any possibility of bringing together the sphincter muscle or that there was one present. Duplay in one case of epispadias with incontinence brought about a complete cure of the incontinence and stated that he had succeeded in bringing about almost a complete cure in another case.

In 1895 Cantwell¹⁴ described an operation for reconstructing the urethra in epispadias. In doing an autopsy on a boy who had com-

complete (Figs 98, 99 and 100) The first two need no comment other than to state that glandular epispadias is rare In complete epispadias the condition somewhat resembles exstrophy of the bladder in that the symphysis pubis is widely separated and the urinary sphincters totally incompetent While it is easy to explain the origin of hypospadias as an arrest of fetal development, no satisfactory explanation has been put forward for the occurrence of the urethra on the dorsal surface of the penis in epispadias

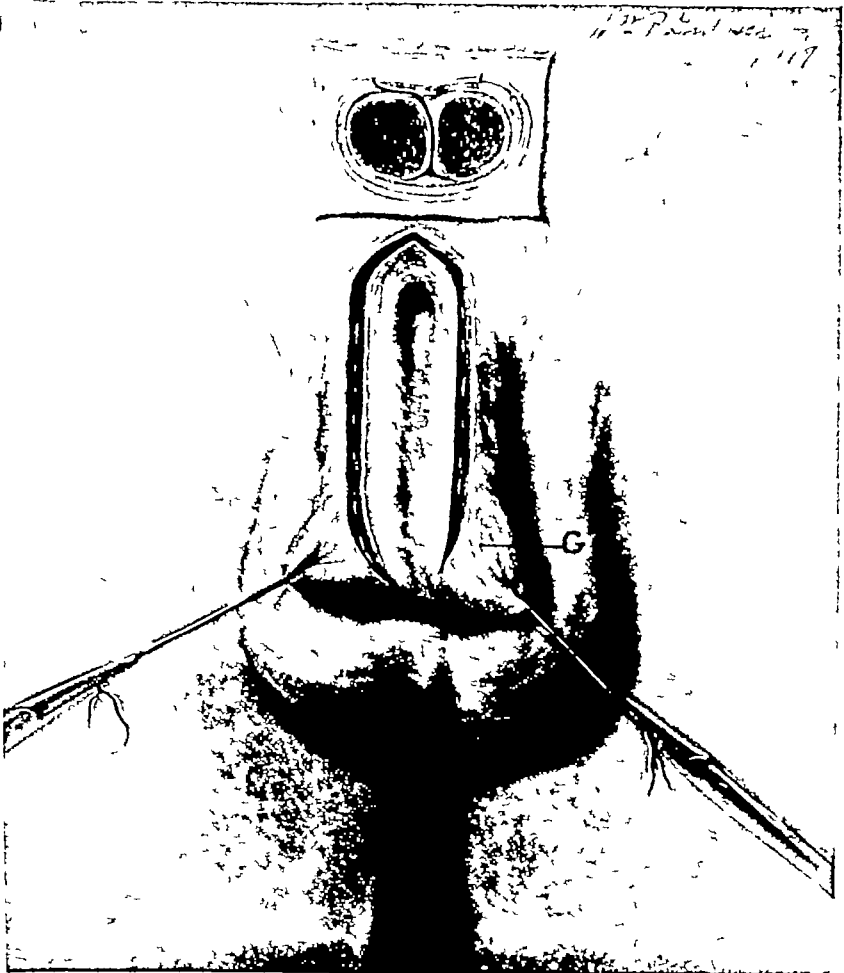


FIG 101 —Skin incision The penis is held in position by two sutures placed in glands (G) As indicated by the black line in the diagrammatic cross-section, the incision on the left side goes only through the skin and down to the corpus, while, on the right, the dissection is carried down between the corpora until the skin of the under surface of the penis is reached (Young)

The earliest operators in the treatment of epispadias were concerned only with the making of a urinary channel along which the urine could flow When Thiersch¹¹ developed his flap operation which Billroth¹² spoke of as one of the most brilliant in plastic surgery, he noted that some of his patients gained some slight degree of control of urine, and he managed to bring about a fairly comfortable living

fibers of the neck of the bladder. If the two ends of these fibers could be reunited the functions of the neck of the bladder would be restored particularly voluntary micturition. I have used this operative plan in a youth of fifteen years with complete epispadias and absolute incontinence of urine. First I performed a symphysectomy on the principles formulated by Farabeuf. Thus I exposed for the length of

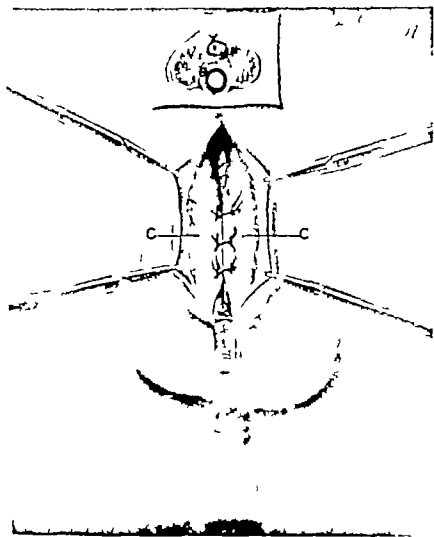


FIG. 104.—The right corpus (C) has been rotated, carrying the urethra down to its new position below and between the two corpora. The latter are being sutured with interrupted sutures of chromic catgut. The unfinished suture line above permits a view of the underlying newly formed urethra. (Young.)

5 cm. the region of the neck of the bladder and of the prostate where the mucosa was present only along the median line. I dissected on the sides until I came to the thick fleshy parts which I was able to suture with catgut and bring over to the median line over the mucosa left intact at the bottom of the wound and turned back like a fold on the side of the canal. Next, I sutured the symphysis with silk and put a separate dressing under a bandage on the body firmly placed

mitted suicide and who had complete epispadias he noted the ease with which the cavernous bodies could be separated, and it was this that led him to the development of the operation of separating the cavernous bodies and burying the urethra down between them so that it might occupy a practically normal position Cantwell thought that some of his patients had some improvement in the control of miction, and in this he was borne out by the observation of Palham⁶⁰

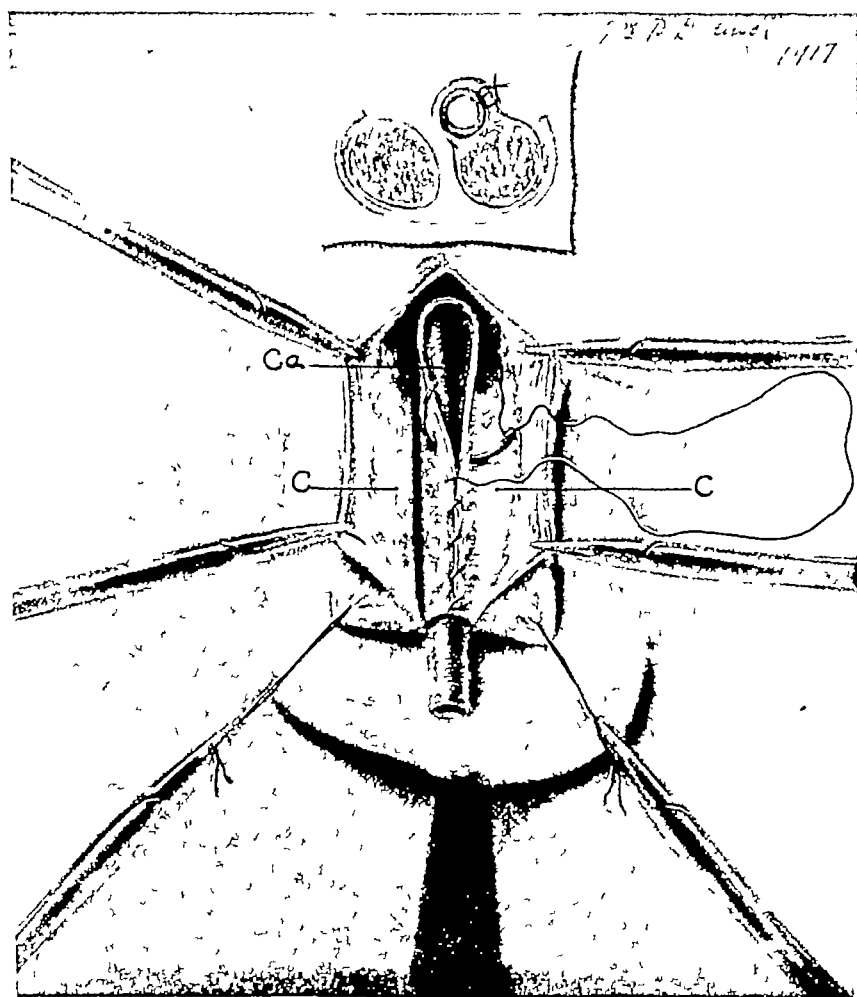


FIG 103 —The new urethra is being formed by a continuous suture, bringing together, over a catheter (Ca) the edges produced by the original incision, and converting the original groove into a tube The attachment of the urethral tube to the left corpus may be distinctly seen both in surface view and cross-section

Page⁶¹ reported a case in which complete control followed the operation, but Cantwell did not operate with any idea of curing urinary incontinence

Then, in 1895, appeared a very significant article, and so significant that I shall quote fully from it Boiffin,⁶² writing on epispadias, had the following to say

“Incontinence of urine is due to a deep division of the circular

existing incontinence may be overcome by direct suture of the urethra after the free edges of the latter have been freshened. He further states that in the extreme degrees where the neck of the bladder will admit the finger that it is merely necessary in such cases to bring about a narrowing of the muscular ring around the neck of the bladder by an excision of a sufficiently wide wedge-shaped section from the upper

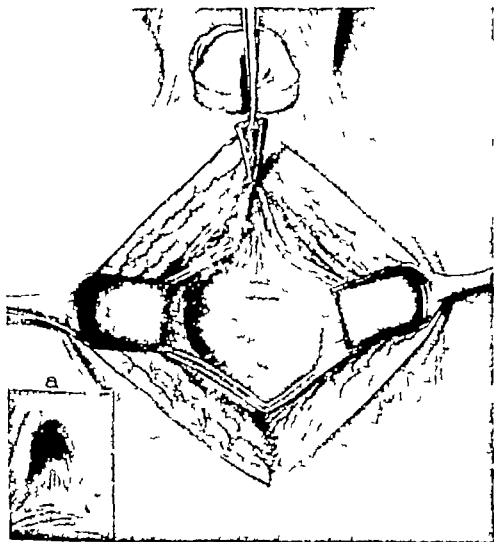


FIG. 100.—Young's operation for the cure of incontinence associated with epispadias. At A the dilated vesical orifice is shown. The trigone is atrophied. The cystostomy incision is extended into the urethra and the triangular piece removed from the anterior urethral wall of sufficient size so that when the urethra is reconstructed the caliber of the urethral orifice will be normal.

border of the infundibulum and then carefully closing the gap with catgut sutures. His procedure consisted in cutting between the pubic bones and approaching the vesical neck in this manner. He states that enough tissue should then be removed to leave a broad bleeding surface which may then be approximated with catgut sutures. At the region of the neck of the bladder the edges are turned in and

The child got up on the twenty-fifth day, with no difficulty in walking, and urinated voluntarily every two or three hours. He had removed the rubber catheter. I propose to carry his urethral canal to the end of the penis soon."

Even this author did not impress surgeons with the possibility of being able to cure incontinence with epispadias.

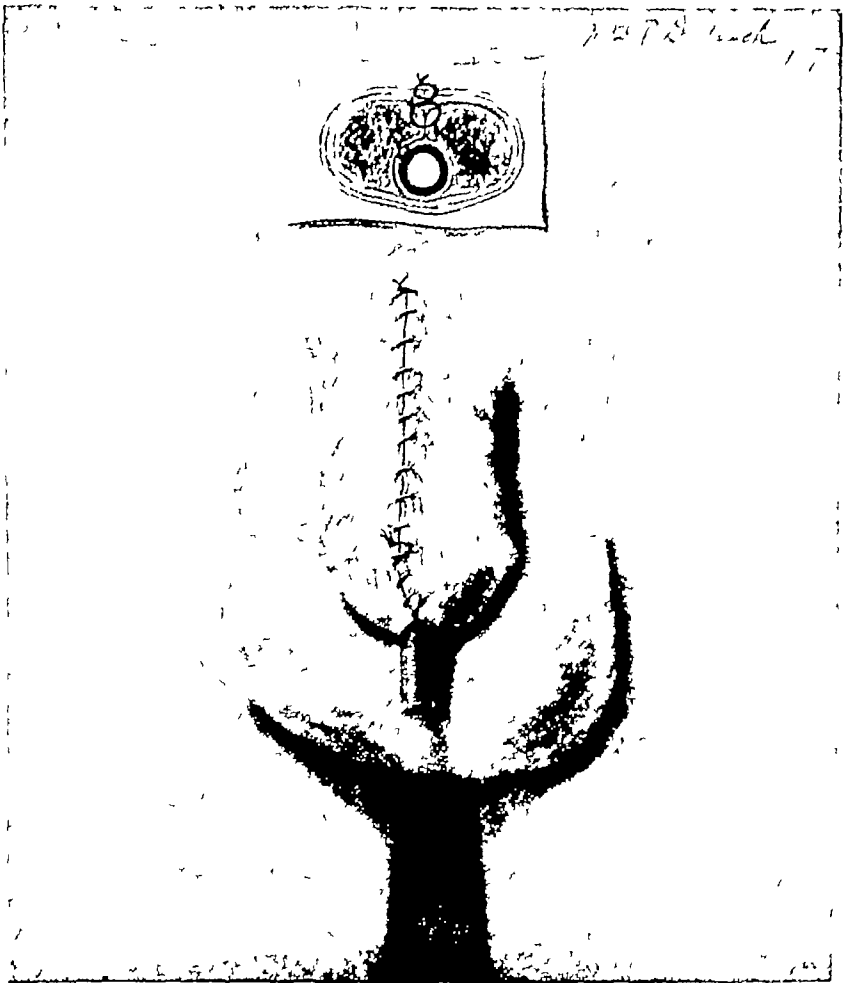


FIG 105 —The operation completed. The two outer edges of the original incision were easily brought together in the midline making a penis and glans almost normal in appearance. (Young)

Another significant article of tremendous bearing on the subject is the work of Trendelenburg,⁶³ who from his work on exstrophy of the bladder, reached the conclusion that the physiological factors necessary both for retention and voluntary micturition are present and that they are merely prevented from functioning in a normal manner by certain mechanical conditions such as the pelvis attempting to go back to its former state after having been reconstructed. Trendelenburg in this article states that it is well known that in certain cases of epispadias where the infundibulum is narrow that the previously

urethral tube the blood supply of which is maintained by leaving a portion of the newly formed urethra attached to one of the cavernous bodies. By the rotation then of the cavernous bodies the urethra was buried between them in a normal position near the ventral surface (Figs. 101 102 103 104 and 105)

The part of Young's operation previously described has to deal with the reconstruction of the urethra in penile epispadias without incontinence. In 1922 Young⁶⁴ described his operation for the cure

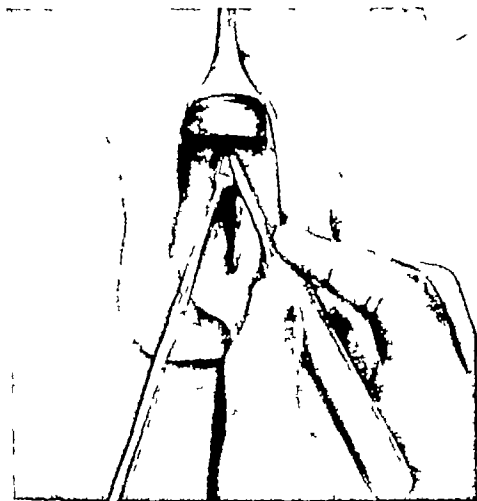


FIG. 108.—Operation for the cure of epispadias. The roof of membranous urethra is being excised through epispadias cavity held open by retractor (Young.)

of incontinence associated with complete epispadias. This operation consisted in bringing together the vesical sphincter by suprapubic approach (Figs. 106 and 107) and by further attack on the external sphincter beneath the symphyseal band. He invented his Boomerang needle-holder for facilitating the placing of the deep sutures (Figs. 107 and 109). Having reconstructed the sphincters Young then in a subsequent operation reconstructed the urethra as described above. Young's work was epoch making in teaching surgeons that the vesical

brought together with Lembert sutures. He advises using a catheter during operation but this should be removed at the close of the operation and put in a suprapubic drain which was introduced through the top of the bladder by a special opening made in the anterior wall. The suturing of the skin would then complete the operation. He states that by this operation he got a perfect result in a boy aged twelve years. Neither the work of Boiffin nor the work of Trendelenburg seemed to

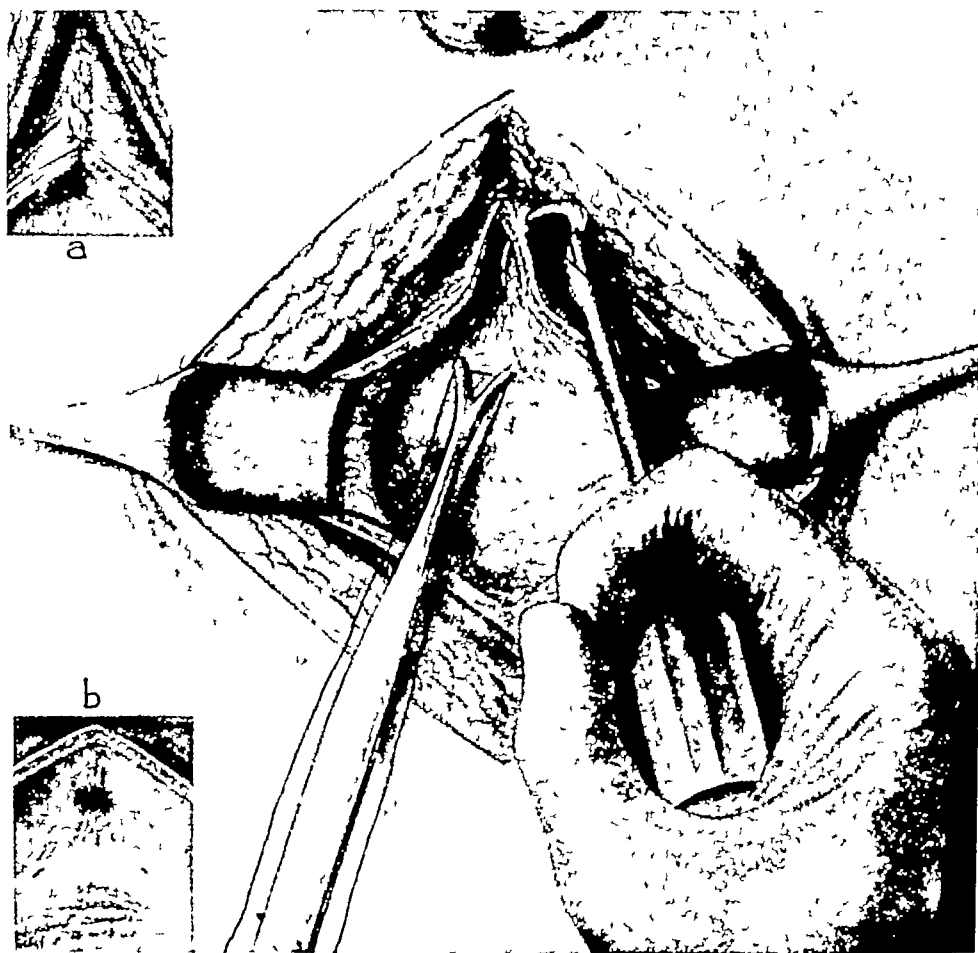


FIG. 107 — Operation for the cure of epispadias. Showing approximation of cut edges of prostate with boomerang needle-holder and resultant closure of prostatic orifice (a) Closure of prostate completed, (b) vesical orifice, internal sphincter, after suture (Young)

make any great impression, for we still find many years later surgeons concerned only with the reconstruction of the urinary channel.

In 1920 Thompson⁶⁴ attempted to use the rectus muscle for reconstructing the sphincter in a case of epispadias with incontinence. Apparently he got some result but the article does not say whether the boy was completely cured or not.

In 1918 Young⁶⁵ described an operation for the reconstruction of the urethra in epispadias which consisted in the formation of an

neck and urethra could be successfully reconstructed and is the ideal to which all surgical procedures should be directed in the treatment of complete epispadias with incontinence. I feel that there has been too much tendency to resort to the transplantation of the ureters to the bowel rather than to make an effort to bring about normal urination and normal bladder control.

Muschat⁴⁷ has reported successful cases in addition to those reported by Young and by Sanchez-Cayusa.⁴⁸



FIG. 111



FIG. 112

FIG. 111 — Epispadias with incontinence. Reconstruction of the vesical neck and urethra to the end of the penis. Note that the penis hangs in a rather normal position in spite of the fact that no redrapement was done other than bringing the corpora cavernosa together.

FIG. 112 — Cure of epispadias with incontinence of urine. Note large size stream, good force.

Following Young's technique I have succeeded in curing one patient of epispadias with incontinence of urine. The deformity in this case was extreme; the pubic bones were widely separated. One could easily pass a finger into the bladder. There was absolutely no possibility of retention of urine. This boy is now seventeen years of age and is well developed. He does not get up at night to urinate and voids normally during the day. He attended high school and took an active part in athletics. Radiograph of this case is shown in Fig. 110 and photographs are shown in Figs. 111 and 112.

Other operations have been devised. Rockey⁴⁹ in 1928 brought

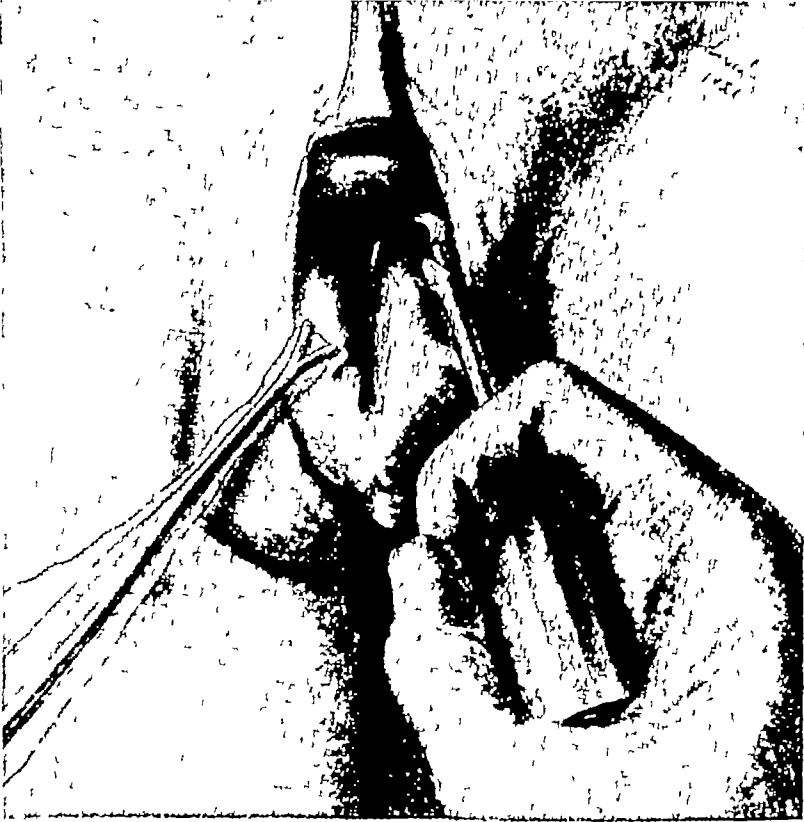


FIG 109 —Operation for the cure of epispadias Placing of sutures in roof of membranous urethra to tighten external sphincter with boomerang needle-holder (Young)



FIG 110 —Radiograph of case of epispadias with incontinence Note marked separation of pubic bones

fistulous tract opening into the urethra in the treatment of both *hypopadias* and *epipadias*. I do not believe it is advisable to widely excise this fistulous tract as doing so will necessarily bring about considerable constriction of the urethra. As a rule scar formation is not great and I have found it advisable to undercut the edges of the fistulous tract separating the urethral tube from the skin. The edges of the urethral tube are allowed to fall together and the skin edges are approximated with relatively broad surfaces. Complete diversion of the urinary stream is absolutely necessary for the success of this operation (Fig. 113)



FIG. 114

Double Penis.—Double penis or diphallus is an extremely rare condition. Nesbit and Bromme⁷¹ who have recently reviewed the literature found that 45 cases have been reported since the first case was described by Wecker⁷² in 1600. Three cases have been reported in the American literature: 1 by Keyes⁷³, 1 by Seth and Peacock⁷⁴ and 1 by Nesbit and Bromme (Fig. 114). Donald⁷⁵ has reported a case of diphallus in which he obtained an autopsy. The condition occurs in several forms. There may be double glans with a single shaft, two separate penes which may be superimposed, placed side by side or separate, or a supernumerary penis without function. In Seth and Peacock's case there was one bladder and one urethra. In Nesbit and Bromme's case there were two bladders and two urethrae. The urine may be voided at will from either urethra as in the case of Alan P. Smith⁷⁶. One penis may be used for urination and the other for copulation or both urine and semen may be passed by both urethrae.

about the control of urine in a boy aged four years by the use of the gracilis muscle as was originated by Deming ⁷⁰

Complications in the Treatment of Hypospadias and Epispadias — There are various complications that arise in the treatment of congenital defects of the urethra. I have already spoken of the great tendency of children to form lime salts that are likely to occlude the drainage tubes. This may occur within a very short period of time and must be constantly watched for and guarded against. It is not uncommon for plastic flaps to develop beneath them small blebs which terminate

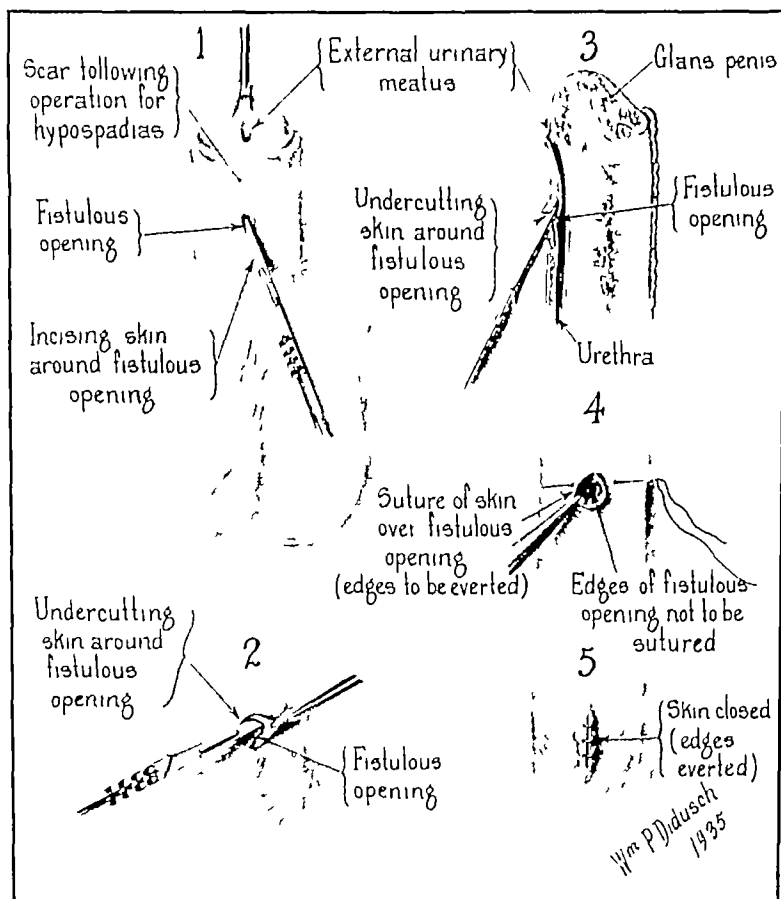


FIG 113

in bluish areas of the skin the center eventually necrosing and the skin breaking down at this point. At the first appearance of such blebs they should be tapped with a small hypodermic needle and the underlying serum withdrawn. In epispadias where the corpora cavernosa are rotated inward and sutured together, considerable tension is brought on the root of the penis so that the blood supply may be interfered with. One must expect a fair amount of edema and the penis has to be very carefully watched to avoid any possibility of gangrene. In spite of every care one will sometimes meet with a

Concealed Penis.—Must be distinguished from absence of the penis. In these cases the rudimentary penis lies beneath the skin of the scrotum or perineum.

Torsion.—The penis may be twisted on its long axis so that the frenum comes to occupy a mid-dorsal position. It is usually associated with hypospadias or other penile defects, although a case reported by Caddy⁵¹ showed no other defects. Other cases have been reported by Jacobson⁵² and Rocher.⁵³

Webbed Penis.—The penis may be enclosed throughout its entire extent by the skin of the scrotum. More commonly the attachment of the scrotum extends forward along the under surface of the penis to a varying degree.



FIG. 116



FIG. 117

Cartilaginous and Bony Formation.—Many mammals possess an os penis. In certain cases of Peyronie's disease ossification is found. Cases have been reported by Rokitsansky and Demarquay,⁵⁴ by Chetwood⁵⁵ and by Erdman.⁵⁶ Vermooten⁵⁷ has recently reported a case of ossification in the glans penis which followed a gunshot injury. Ossification was demonstrated by roentgen ray. Upon microscopic examination the mass removed in this case was proven to be made up of true bone, bone marrow and cartilage.

Cleft Penis.—According to Fowler⁵⁸ there is only 1 case of transverse cleft penis on record, a case described by Hofmohl.⁵⁹ In this

The condition is likely to be associated with other abnormalities, among the most frequent of which are hypospadias, epispadias, exstrophy, cleft scrotum, undescended testes and imperforated anus. The prepuce may be absent on one penis. There are four hypotheses as to the cause of double penis: (1) That the urinary bladder, the prostatic urethra and the penis are derived from a bilateral anlagen which by the fusion in embryonic life produces normally single end-products. Double penis and double bladder becomes from this ontogenetic point of view the end result of normal development of abnormally incompletely fused anlagen. (2) It has been suggested that double penis may be an atavism, as snakes and lizards normally possess two complete external genitals. (3) That it is a teratoid structure classified among the double monsters. (4) That it is a minor degree of duplication of the individual such as is represented by supernumerary digits.



FIG 115

Absence of the Penis—Eight cases of congenital absence of the penis have been reported. The literature was recently reviewed by Drury and Schwarzell.⁷⁶ They also reported a case of a boy aged thirteen years whose scrotum and testicles were normal but there was a complete absence of the penis (Fig 115). The urethra opened on the anterior rectal wall. Both ureters showed dilatation. A somewhat similar case has been reported by Roy.⁷⁸ This boy complained of pain in the abdomen due to overdistention of the bladder which was relieved by dilating the abnormal urethral opening that emptied into the rectum. The scrotum and testicles were normal in the cases that have been reported. In some instances areas of the erectile tissue have been found in the perineum and within the rectal wall.

Absence of the Glans Penis—But 2 cases of this condition have been reported, one by Atkinson⁷⁹ and the other by De la Pena.⁸⁰

Dislocation of the Penis.—The penis may be dislocated either in adult life or in childhood so that it is entirely separated from its skin covering and displaced under the skin of the scrotum, pubes or thigh. It may not be apparent at first because the skin of the penis may be filled with blood clots. One should carefully search for any ruptures of the urethral and for extravasation of urine. According to Fowler²⁵ in at least 2 cases (Nelson and Guth) the penis was replaced in its sheath with excellent results. The urinary stream should be diverted preferably by perineal section.

Strangulation of the Penis.—Strangulation of the penis is a fairly common condition. In one case that I saw the penis had undergone gangrene and entirely sloughed away as the result of a nurse tying a string around the child's penis to prevent him from wetting the bed. In another case the penis had been put through a large bushing with resulting edema and threatening gangrene. Vermooten²⁶ from Young's Clinic has reported such a case and the literature is filled with cases where individuals have embellished their penis by various forms of plumbing fixtures, household articles, bottles, etc. For the metallic contraptions a rapidly revolving buzz saw is used for the removal of such objects. Usually the penis if it has not undergone gangrene as it many times does is so edematous that the object cannot otherwise be removed from it. Ehrlich²⁷ has recently reported a case that is of practical importance. The patient had had a dressing held in place on the penis by a rubber band. During the night the dressing came off and the rubber band which had been used for holding the dressing in place had sloughed through into the urethra.

Injuries Due to Chemicals.—Most chemical injuries of the penis result from the use of various drugs for the prevention of venereal disease, among the most common of which are the chemical injuries due to strong bichloride of mercury solutions. I one time treated a man who had plunged his penis into a beaker of pure carbolic acid mistaking it for hydrogen peroxide. In spite of the enormous sloughing the penis eventually became practically normal. In the treatment of all injuries and wounds of the penis one should be extremely conservative as the penis has a great power of recuperation due to its rich blood supply.

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Congenital Canals and Cysts of the Genito-perineal Raphé.—Neff⁹¹ has reported 6 cases of canals and cysts occurring along the genito-perineal raphé and believes that both the cysts and canals have a common developmental origin (Figs 116 and 117). Two explanations have been offered as to the origin, first that they arise from epithelial rests incident to incomplete closure of the urethral or genital folds and, second, that they develop from split-off outgrowths of embryonic epithelium after primary closure of the folds. The lining cells would be columnar if the cyst or canal took origin from the primitive urethra or they would be squamous if they took origin from cell rests at or near the skin level. It is seldom that the canals give any indication of their presence unless they become infected, usually with gonococcus. Cysts have been reported so large as to interfere with copulation. The treatment consists in excising the cysts or the canals if they give trouble.

WOUNDS AND INJURIES OF THE PENIS

Subcutaneous Injuries of the Penis.—All injuries of the penis are likely to be associated with edema, and in many subcutaneous injuries there may be considerable extravasation of blood. So-called fracture of the penis consists in a rupture of the fibrous envelope of the cavernous bodies, and is a misnomer in that the human penis does not normally contain bone. The large majority of subcutaneous injuries of the penis occur during erection. The treatment of these injuries consists of rest, hot moist compresses and elevation of the part. In cases of rupture of the sheath of the cavernous bodies, it may be necessary to suture the sheath after evacuation of the blood clot and control of hemorrhage.

Open Wounds of the Penis.—The most common wound of the penis is tearing of the frenum or tearing of the prepuce in cases of phimosis. Where the frenum has been torn and hemorrhage is profuse, the frenal artery must be ligated.

It is not uncommon for the penis to be amputated through maliciousness. Veseen and O'Neill⁹² have reported a case in which all of the skin was denuded from the penis. This was treated by burying the penis under a raised skin flap of the scrotum with perfect result. It was impossible to find out the cause of the denudation.

Gunshot Wounds.—Otis⁹³ collected 30 cases of gunshot wounds of the penis during the Civil War, and Young⁴ reported only 43 penile wounds in the American forces during the World War. Ritch⁹⁴ has reported the removal of an embedded revolver bullet in the penis.

Dislocation of the Penis The penis may be dislocated either in adult life or in childhood so that it is entirely separated from its skin covering and displaced under the skin of the scrotum, pubes or thigh. It may not be apparent at first because the skin of the penis may be filled with blood clots. One should carefully search for any ruptures of the urethral and for extravasation of urine. According to Fowler¹ in at least 2 cases (Nelson and Cuth) the penis was replaced in its sheath with excellent results. The urinary stream should be diverted preferably by perineal section.

Strangulation of the Penis—Strangulation of the penis is a fairly common condition. In one case that I saw the penis had undergone gangrene and entirely sloughed away as the result of a nurse tying a string around the child's penis to prevent him from wetting the bed. In another case the penis had been put through a large bushing with resulting edema and threatening gangrene. Vermooten² from Young's Clinic has reported such a case and the literature is filled with cases where individuals have embellished their penis by various forms of plumbing fixtures, household articles, bottles, etc. For the removal of such objects, usually the penis if it has not undergone gangrene as it many times does is so edematous that the object cannot otherwise be removed from it. Ehrlich³ has recently reported a case that is of practical importance. The patient had had a dressing held in place on the penis by a rubber band. During the night the dressing came off and the rubber band which had been used for holding the dressing in place had sloughed through into the urethra.

Injuries Due to Chemicals.—Most chemical injuries of the penis result from the use of various drugs for the prevention of venereal disease, among the most common of which are the chemical injuries due to strong bichloride of mercury solutions. I one time treated a man who had plunged his penis into a beaker of pure carbolic acid mistaking it for hydrogen peroxide. In spite of the enormous sloughing the penis eventually became practically normal. In the treatment of all injuries and wounds of the penis one should be extremely conservative, as the penis has a great power of recuperation due to its rich blood supply.

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CHAPTER V

DISEASES OF THE PENIS

BY ARTHUR B. CECIL, M.D., F.A.C.S.

NEOPLASMS OF THE PENIS

Benign Growths.—With the exception of venereal warts or verrucae which have a tendency to become malignant benign tumors of the penis are rare. Venereal warts are usually found back of the corona or on the inner lining of the prepuce. They occur in individuals with long foreskins and are said to be more common where cleanliness is not regarded. They take on a cauliflower appearance and under the microscope show papilla covered with stratified epithelium. These growths may also appear in the urethra. It is most important that venereal warts be destroyed on account of their tendency to undergo malignant changes. They respond promptly to fulguration. An injection of 1 per cent novocain is made and the wart is then fulgurated. The charred portion is lifted off with forceps and the tuft of blood vessels beneath is again fulgurated. Hemangiomas occur but are rare. A case has been reported by Gibson.¹ Other cases have been reported by Kroll,² Lowenthal,³ and Young.⁴ Sebaceous cysts are not infrequently found. Smith⁵ has reported a case of keloid of the penis affecting the prepuce following an injury. Cutaneous horns of the penis have been reported. Goldstein⁶ has recently written on this subject and states that these horns are most frequently found in aged people. They are usually of a brownish-gray color but may be black or yellow. They rarely attain the length of 1 inch. As a rule they are single but multiple lesions may occur. The pathological background is a hypertrophy and cornification of the epithelium, the keratinization of epithelium piling up to produce the horn. When they undergo malignant changes the metastatic changes are found to be epidermoid carcinoma. Varicose veins on the penis are often seen. They occur on the dorsum or the lateral aspects. Lymph varices also occur. They are found in the coronary sulcus and on the dorsal surface in the region of the dorsal lymphatic channels.

Malignant Growths.—**Carcinoma.**—Carcinoma of the penis makes up approximately 2 per cent of all cancers found in men and according to Wolbarst,⁷ accounts for approximately 225 deaths in the United States each year.

The large majority of cases of carcinoma of the penis are found in the cancer age, that is, from forty to sixty years of age. On the other hand a fairly large number of cases are found under forty years of age. Barney⁸ in his classical study of 100 cases of carcinoma of the

penis, found 1 case between twenty-five and thirty years of age and 14 cases between thirty and forty years of age Dean,⁹ in his study, found 8 per cent between twenty-one and thirty years of age, the youngest being aged twenty-one years There does not appear to be any racial immunity to cancer of the penis Parsons,¹⁰ of the United States Navy, found the occurrence of carcinoma of the penis among the Haitians very high and attributed this to phimosis and poor hygienic conditions In this connection it is interesting to note that Wolbarst, in a very extensive study, states that he was unable to find a single case of carcinoma in a circumcised Jew He did not believe that this was dependent upon racial immunity, as he reported a case of carcinoma of the penis in an uncircumcised Jew and further found that the condition was very rare among Mohammedans but did occur in a small percentage of cases This distinction between no cases being found in Jews and the small percentage that did occur among the Mohammedans led him to the belief that this was due to changes that occurred early in life, before the eighth year Jewish ritual circumcision is carried out on the eighth day Mohammedan ritual circumcision is carried out between the fourth and eighth year

Wolbarst studies in the main are extremely convincing and cannot help but lead to the impression that a large number of lives could be saved each year were circumcision practised as a routine during infancy It seems evident, therefore, that phimosis of the penis is one of the principal predisposing causes of carcinoma and that the retained smegma and urine set up chronic irritations that result in cancerous changes The fact that the foreskin is retractable does not mean that balanoposthitis might not be present It is very doubtful whether carcinoma of the cervix in a man's wife is ever transplanted to the penis, although such coincidences have been reported

Healed chancroidal lesions seem to be predisposing causes Occasionally carcinoma has occurred in a circumcision wound in the adult, but it is possible that in these cases carcinoma was already present and that circumcision may have been carried out on account of it, the wound never healing One should be suspicious of any lesion following circumcision which does not promptly heal Papillomatous vegetations are undoubtedly a predisposing cause of cancer, and trauma must be considered as an exciting cause Any intractable ulceration should be studied histologically for malignancy

Symptoms —The disease first makes its appearance either as a small sore on the penis or as a papillary or cauliflower growth, the latter sooner or later becoming ulcerated As a rule, these lesions are found with about equal frequency on the glans penis or on the lining of the prepuce It is the onset of infection that brings on the symptoms of pain, loss of weight, cachexia, and discomfort Dean found that in 58 per cent of the cases pain developed at some time in the course of the disease With the introduction of infection the glands of the groin become enlarged and tender, there is fever, and wasting commences The increase in size of the glands is mostly due to adenitis

and not to malignant metastases. It is Morson's¹¹ belief that sepsis is the most frequent actual cause of death—death in most cases occurring from the sloughing of the inguinal glands and tissues in that region into the femoral artery. In some instances death is the result of terminal septic bronchopneumonia.

Pathology—Histologically both the papillary and flat lesions are squamous-cell epithelioma or epidermoid carcinoma. In rare instances the cells resemble those of the basal cells of the skin and are known as basal-cell carcinomata. Cases of basal-cell carcinoma of the penis have been reported by Jack¹² and by Guicardi and Durant Dastes.¹³ Occasional cases of adenocarcinoma have been seen. Okawa¹⁴ has reported such a case and Paglieri and Schiappapietra¹⁵ have reported a case of metastasis to the corpora cavernosa from an adenocarcinoma of the prostate. I have seen one such case. Goldstein,⁶ Orsós¹⁶ and others have reported malignant degeneration in cutaneous horns on the penis.

The fibrous coverings of the penis—the tunica albuginea and Buck's fascia—serve as barrier against invasion of the cavernous spaces for a considerable time and the corpus spongiosum is the last to be invaded. It is of practical importance that epithelioma of the penis does not send out long processes into the corpora. Kuttner¹⁷ concluded from his studies—this has been borne out by the observation of others since then—that amputation 2 cm. proximal to the border of the palpable induration is always sufficient. As a rule metastasis occurs rather late in the course of the disease, whereas ulceration occurs early. Enlargement of the lymph glands in the groin are secondary to this infection so that it is impossible to tell from palpation whether the enlarged lymph glands are due to metastasis or not. Young¹⁸ states that while it is common to see metastasis in the inguinal glands, intrapelvic masses are by no means rare. (See Anatomy of Lymphatics.) Barnes⁹ found generalized metastasis in 15 per cent of his cases.

Diagnosis and Treatment—The diagnosis of any questionable lesions on the penis should be made by histological study. This is important not only for diagnosis but following Broder's classification of malignant tumors scientific observations will be based upon the intimate details of the cellular structure and arrangement. Colby and Smith¹⁹ from their studies based on 50 cases of carcinoma of the penis reached the conclusion that there was a definite correlation between the grade of malignancy as determined histologically and the clinical course of the disease.

Horn and Nesbit²⁰ have recently reviewed the various methods of treating carcinoma of the penis. In brief the treatment consists of simple amputation, radical amputation with removal of all of the glands draining the region, radiation and various combinations of surgical procedures and radiation. It has generally been stated that carcinoma of the penis is very resistant to radiation and Young depends rather upon amputation of the penis and the carrying out of

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rate of growth of these tumors varies considerably. In 2 of the reported cases the growth had been present for eight years. On the other hand in 1 case there was metastatic involvement of the lymph nodes in nine months after the initial appearance of the lesion. These tumors usually occur on the glans penis or foreskin as a darkly pigmented circular area which may be slightly elevated, a little nodular or with some induration. At first there is no ulceration. They differ from epitheliomata in being beneath the skin. The tumors may become multiple. They metastasize by way of the blood stream producing secondary growths in all of the organs or by way of the lymphatics. In a case reported by Miner²⁰ metastases were found only in the liver. Metastatic melanotic tumors are likely to be found in the skin and have the same dark pigmentation as the primary tumor. The prognosis is bad.

Barringer and Dean²¹ have recently reported 2 cases of Kaposi's disease of the penis. These tumors were originally termed by Kaposi as "idiopathic multiple pigment sarcoma of the skin" and at first were believed to always occur primarily on the sole and dorsum of the foot to be followed by lesions of the hand and finally by similar nodules in the mucous membrane of the larynx, trachea, stomach, intestines and liver. Because of the severe pain associated with the nodules neurogenic origin has been suggested. Bacteria have been held to have been a cause. It has also been suggested that there was some relationship between Kaposi's sarcoma and mycosis fungoides. Adair and Trombley analyzed 17 cases treated at the Memorial Hospital. These are exclusive of the 2 cases of Kaposi's disease of the penis reported by Barringer and Dean. Barringer and Dean's cases of Kaposi's disease of the penis were aged forty-five and fifty-six years respectively. Both lesions appeared on the glans penis with some induration of the corpora. One showed multiple lumps purplish-blue in color exquisitely tender. The other showed a red solid growth not at all painful nor tender. Neither showed ulceration. No treatment had any effect upon the disease until roentgen-ray treatment was instituted which apparently may keep the disease in check almost indefinitely and in some instances causes the nodules to disappear.

Endotheliomata.—Joelson²² in his review of sarcoma of the penis included 9 cases of endotheliomata, 2 of which were in infants. A review of the literature since then reveals that 4 other cases have been reported, 1 each by Balog,²³ Zienkiewicz,²⁴ Dobrzaniecki²⁵ and Mackenzie.²⁶ These tumors are supposed to take origin from the endothelial cells lining the lymph spaces, the cavernous spaces or the blood vessels of the penis. However not all pathologists agree with this idea. Some regard them as having sprung from the epithelium of the urethra and thus classify them as carcinomata rather than endotheliomata. So-called endotheliomata arise from the shaft of the penis and are very rapid in their growth and metastasize early. Metastases have been found in the inguinal lymph nodes, the skin, the subcutaneous tissues, the heart, the pericardium and the lungs. Apparently they

his extensive operation for removal of the glands Graves,²¹ in a recent article has described a modification of Young's procedure, and Hepler²² has described operations for varying degrees of involvement. In any operation in which lymph glands are removed, there is a likelihood of the occurrence of lymphedema of varying degrees, and in one of my cases this was very extreme and persistent. This should be more seriously considered than it has been in carrying out radical operations for carcinoma of the penis, and particularly in view of the fact that in a large number of instances where the radical operation has been done the glands prove to be negative. It has always seemed to me doubtful how many cases of carcinoma in any region were saved by extensive operations for removal of the glands that drain that region. There is one procedure against which I would particularly advise, namely, the removal of the glands previous to amputation of the penis, for lymphedema of such degree is likely to follow that the more important procedure of amputation of the penis becomes difficult, dangerous, and at times impossible.

Barringer²³ and Dean have used irradiation extensively. According to them, if the primary lesion is confined to the foreskin, this should be removed by circumcision. If it is on the glans and less than 2 cm in diameter, superficial external irradiation alone is used. Where the carcinoma has invaded the cavernous tissues, irradiation is used first, followed by conservative amputation. The glands of the groin are irradiated only where they were sure that the glands were carcinomatous, as proven by aspiration biopsy. They state that they are not sure whether this is a better method than surgical removal, as few cures are found following either method. The whole question of radium in the treatment of cancer of the penis must be viewed from two standpoints. Does it offer the better chance of cure in the extreme degree, and is it safe to use in very minor degree as a matter of conservatism? Circumcision in infancy is the greatest prophylaxis against carcinoma of the penis.

Melanomata—Melanomata of the penis are rare tumors. In 1924 Joelson,²⁴ in his studies on sarcomata of the penis, was able to collect only 8 cases from the literature. Since then cases have been reported by Noordenbos,²⁵ by Peters,²⁶ and by Colby.²⁷ These tumors are characterized by black pigmentation. There is a difference of opinion as to whether the pigment-producing cells from which they arise are of epithelial or of mesothelial origin. According to MacCallum,²⁸ it is not possible at this time to form a definite opinion. They are usually spoken of as melanosarcoma. Melanomata, in general, are found in horses, and it is interesting that they are found only in white and gray horses. MacCallum reported that in 12,000 autopsies at the Johns Hopkins Hospital there were 10 cases of melanosarcoma, all of which were in white people, notwithstanding the fact that a large proportion of the autopsies were on negroes. All of the reported cases of melanosarcoma of the penis have occurred in men between forty-eight and seventy-five years of age, and, as pointed out by Colby, the

is found more frequently near the base of the penis. It is relatively superficial but the skin is freely movable over it. It affects the inter-cavernous septum in its dorsal portion and the adjacent tunics of the corpora. Authors differ as to whether it ever actually invades the erectile tissues. Young⁴ states that it never does. Associated with this indurated area is a deformity of the penis on erection which in some instances is so marked as to interfere with sexual intercourse. Other symptoms produced are extreme pain on erection but the lesion may be painful without erection. When these patients are first seen by the physician almost invariably the induration has attained its maximum size and does not tend to further increase in size. The disease usually occurs in middle age although in some instances it has been found in quite young men. Cases have been reported as early as eighteen years of age. Kretschmer has reported a case aged twenty-four years. Of the 14 cases that I have seen the youngest was thirty-nine years of age. Nothing is known as to etiology. Some of the cases are diabetics. Others are syphilitics but the treatment of these conditions which is now so very specific seems to offer nothing toward the cure of the disease and the relationship if any is not clear. Spontaneous cures have been reported. One must therefore necessarily be very careful in attributing cures to the innumerable procedures that have been recommended. The induration may be solitary or multiple and manifest itself as a nodule, plaque or cord, round or irregular in shape, hard, cartilaginous or even bony in consistency. The corpus spongiosum is never affected. The plaques vary in thickness, width and length and are usually situated in the midline of the penis below the dorsal vessels near the base of the penis but may be situated in any part back of the corona. Weidhoff²² in his studies from a section removed concluded that changes in the vascular sheaths in the smaller vessels were the points of origin of the induration. Microscopically the plaque for the most part consists of elastic tissue. No inflammatory changes are found. In some instances there are calcareous deposits others show true bone formation. Two of my cases showed calcareous deposits on roentgen-ray examination. The induration never tends to become malignant. Various treatments have been used treatments for associated diseases, fibrolysin and iodides, diathermy, roentgen ray and surgical removal. Waters and Colston²¹ concluded that roentgenization had no effect in the way of cure. Surgical removal offers some hope in well-chosen cases. Young⁴ has reported a cure of 1 case by surgical removal but failure in 2 cases due to imperfect erection and recurrence of the chordæ which continued

DISEASES OF THE GLANS AND FORESKIN OF THE PENIS

Balanoposthitis.—Balanitis means inflammation of the glans and posthitis inflammation of the foreskin. The two conditions are many times co-existent in what is known as balanoposthitis. The most frequent cause of balanoposthitis is the irritation from a gonorrhœal

may invade any part of the body. The tumor makes its appearance as a painless lump within one of the cavernous bodies and at first without symptoms. By its invasion of the cavernous spaces it produces priapism, and by its encroachment upon the urethra difficulties of urination.

Mesotheliomata — Mesothelial tumors of the penis are principally sarcomata, although Stavianicek³⁵ has described a case of multiple leiomyomata of the penis in a man, aged sixty-three years. None of the growths showed any signs of malignancy. Stavianicek cites from the literature a similar growth described by Nicolai Joelson³⁴ collected 17 cases of round-cell, spindle-cell and mixed-cell sarcoma and fibrosarcoma. To these I would add a case reported by Meller³⁶ which he regarded as myosarcoma, a case reported by Kreibitz,³⁷ in a man, aged fifty-eight years, in which the tumor removed showed areas which looked sarcomatous and in other places like a leiomyoma, a case reported by Puhl³⁸ of a rhabdomyosarcoma in a boy, aged eight years, a case reported by Levi³⁹ of a fibrosarcoma in a man, aged thirty-eight years, a case reported by Mollo⁴⁰ of sarcoma, and a case reported by Mark⁴¹ in a man, aged thirty-one years, which proved to be a round-cell sarcoma. Chauvin and Empeaire⁴² have reported a case of sarcoma of the prostate with metastases to the penis. Sarcomata of the penis usually originates in the cavernous bodies but may originate in the glans. Two of the cases were in boys, aged eight years. In Mark's case there were metastatic growths to the liver and skin. Young⁴ states that these tumors are differentiated from endotheliomata in producing a definite rounded nodule rather than a diffuse infiltration. The round-cell sarcomata are more malignant than the fibrosarcomata, spindle-cell, round-cell or mixed-cell sarcomata.

Cavernositis — *Acute Cavernositis* — There may be inflammation of the cavernous bodies as the direct result of injury or due to extravasation of urine back of a urethral stricture or to secondary infection of thrombosis of the cavernous spaces. Thrombosis of the cavernous spaces may be present without demonstrable cause as was the situation in a case reported by Graves⁴³. Priapism is a common symptom. Gangrene of the penis may follow a fulminating infection. Septicemia and death may occur.

Chronic Cavernositis — La Peyronie's disease, circumscribed fibrosis, primary indurative cavernositis, plastic induration of the penis, fibrous induration, fibrous plaque, fibroid sclerosis, and fibrous cavernositis are all terms used to describe a condition which was first fully described by La Peyronie⁴⁴ in 1743, although in a most comprehensive review on this subject by Polkey⁴⁵ mention is made of a case being described by Ephemerides⁴⁶ in 1687 and another by Becker⁴⁷ in 1729. Corbineau's⁴⁸ studies are most valuable as are the studies of Kretschmer and Fister.⁴⁹ Chronic cavernositis is one of the more common of the rarer diseases of the penis. It is characterized by a rather superficial node or plaque with quite circumscribed edges which occurs on the dorsum of the penis, usually in the midline but may be to either side. The induration

unknown lesion in the preputial sac that one wishes to explore. The various plastic operations described do not have back of them such a history of prophylaxis against carcinoma as does circumcision and it is doubtful as to whether they produce the same functional results.

Tuberculosis.—Tuberculosis of the penis is sometimes seen in infants following ritual circumcision. In this way the penis was sometimes infected by tuberculous sputum, the incubation period being about two weeks. The condition is manifested by a typical yellowish-gray-white military tubercle which progresses rapidly, the inguinal glands becoming involved early. A few cases have been reported where the lesion has healed but as a rule the child dies of tuberculosis elsewhere. Tuberculosis of the penis in adults is much rarer but here too may be due to tuberculous sputum or more rarely secondary to a tuberculous process in the urinary tract. If this happens the meatus becomes swollen and small military tubercles are seen over the surface. In some instances the cavernous bodies become involved which upon section show caseous tubercles. The skin may ulcerate giving the appearance of a hard chancre. The penis may be the subject of tuberculosis by a blood stream infection. Microscopic examination will aid in the correct diagnosis.

Herpes Præputialis.—Herpes præputialis has a definite sequence as a papule vesicle pustule and ulcer. As a rule there is a history of previous attacks. The eruption is always preceded by itching and burning and a cluster of white spots beneath the skin which is often mistaken for venereal sores. The condition usually lasts about six days, providing the ulcerations do not become secondarily infected. The subjects of herpes præputialis should be most careful about promiscuous intercourse as the ulcerations offer splendid opportunities for infection. The cause of the condition is not known. It has been said to have some relationship to nervous depression, digestive disturbances, sexual excesses, etc. I know of nothing that prevents the attack.

Herpes Zoster.—Herpes zoster may occur on the penis as elsewhere but it rarely appears in this region.

Diphtheria.—Diphtheria of the penis may be secondary to diphtheritic lesions elsewhere in the body or may be primary on the genitals. It may follow circumcision. The glans and mucous surface of the prepuce are covered with a grayish yellow exudate which is firmly adherent while the shaft is red and edematous. The inguinal glands are enlarged and tender. There are signs of systemic infection and positive cultures.

Actinomycosis.—Actinomycosis is due to infection with organisms to which the general term streptothricosis has been given. Apparently there are many species of this organism. It may survive in the dry state for months or years and the ordinary habitat is in the soil or various kinds of grasses and grains. It therefore gains access to the bovine or human body usually through the buccal mucosa but may enter the body through wounds or scratches or through the lungs

discharge Non-venereal balanitis is subacute and is found in subjects of phimosis Balanitis also occurs in diabetics, particularly diabetics with phimosis Long-continued balanitis is a predisposing cause to epithelioma Balanoposthitis associated with venereal disease can usually be cured by cleanliness, the parts being kept clean and dry In diabetic balanitis the condition must be treated both generally and locally, and only after it has been treated generally should circumcision be done In acute balanoposthitis with marked phimosis, dorsal slits or lateral slits may be necessary for cleanliness In chronic balanoposthitis circumcision should be carried out

Phimosis —Phimosis exists when the opening of the foreskin is so small as to not permit of easy retraction over the glans penis It varies in degree all the way from a considerable tightness to total inability to retract the foreskin Practically all infants have phimosis, but by the time of puberty the foreskin usually is easily retracted over the glans Phimosis may be congenital or may result from inflammatory processes, causing a thickening of the preputial orifice so that it contracts down and does not permit of easy exposure of the glans The work of Wolbarst in showing that no Jew circumcised in infancy has ever developed carcinoma is sufficient proof of the value of circumcision in infancy whether phimosis is present or not, and certainly in all cases of balanoposthitis due to phimosis and of thickening and irritation of the foreskin due to inflammatory process which have caused phimosis, circumcision should be done

Paraphimosis —Paraphimosis is that condition in which the foreskin has been retracted and it is impossible to replace it over the glans In this condition there is great swelling of the glans penis and marked subcutaneous edema There is always a deep sulcus in the depths of which is found a tight stricture of the prepuce Keyes⁵² has described a method for the reduction of this condition, which I shall quote "The following is the best method of reduction Seize the penis behind the strictured prepuce in the fork of the index and middle fingers of both hands, one placed on each side Now make pressure with the thumbs on both sides, in such a direction as to compress the glans laterally, rather than from before backward, and at the same time pull the strictured portion of the prepuce forward, the effort being rather to pull the stricture over the glans than to push the glans through the stricture If a prolonged, careful attempt at reduction fails, the strictured point must be divided This may be done under local anesthesia After reduction the treatment consists in elevation of the penis within a jock-strap, and syringing the preputial cavity with a mild antiseptic solution When the edema has subsided, circumcision should be performed "

Operations for Phimosis —Various operations have been devised for phimosis Phimotomy, circumcision and various plastic procedures, such as those described by Polya,⁵³ by Linhart,⁵⁴ by Pagenstecher,⁵⁵ and by Tobiassek,⁵⁶ and Druener⁵⁷ Plastic operations are not indicated where there is an acute balanoposthitis nor where there is an

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by inhalation. Microscopically one finds a fine, branching mycelium which is Gram-positive when young, but later small Gram-positive granules make their appearance in the mycelial threads and the remainder becomes Gram-negative. Finally the threads break into short bacillus-like rods, which may be Gram-positive or Gram-negative, and into small, round, coccus-like bodies, always Gram-positive. The organisms may thus take the form of a mycelium, a bacillus or a coccus. From the very nature of things actinomycosis of the penis must be extremely rare. In a study made by Hill and Cecil⁴ on primary genito-urinary actinomycosis, no penile lesions were found. Leger⁵⁸ has reported a case with a skin lesion on the glans penis. According to Diasio,⁵⁹ in these cases the glans is indurated, covered with many small purulent knotty masses, punctured by small holes from which a serosanguineous secretion exudates. Pain is an early concomitant. The ray fungus can be demonstrated in the secretion. The treatment of actinomycosis is unsatisfactory and the prognosis is bad. Iodides have been recommended. Wide surgical removal, if possible, would seem to be the best form of treatment.

Preputial Calculi.—Joly⁶⁰ in his work on calculus diseases of the urinary tract has described the occurrence of preputial calculi. He states that stones have been found as large as a hen's egg in a boy, aged eight years, and as large as a clenched fist in adults. Stones in this region, associated with marked balanoposthitis, present a foul-smelling and occasionally bloody discharge from the preputial sac. Urination may be difficult. Preputial stones are always secondary to phimosis and, according to Joly, three types are found. Those that are formed by lime salts being deposited on epithelial cells and smegma of the preputial sac, those that are made up as urinary calculi from stagnant decomposing urine in the preputial sac. These are usually composed of ammonio-magnesium phosphate and calcium phosphate, but many contain oxalates, etc., and a third type, which are migratory stones originating either in the kidneys or bladder and caught in the phimotic preputial sac. The treatment consists in circumcision. Joly points out that before doing a radical operation for carcinoma of the penis that the prepuce should be split open for exploration, as the indurated mass may be due to preputial calculi rather than carcinoma.

Elephantiasis—True elephantiasis of the penis is due to infection with filaria. The penis may reach enormous size and the skin show marked thickening. Filaria can be demonstrated in the blood stream. The most frequent type of elephantiasis of the penis is that which follows complete destruction of the inguinal glands, either by operation or by inflammation. See also Chapter XI on Diseases of the Scrotum.

Priapism—Priapism is a condition in which there is continuous erection of the penis unaccompanied by sexual desire, usually more or less painful and not relieved by sexual intercourse. Ejaculation may take place if intercourse is attempted. In addition to the symptoms of pain, there may be difficulty in urination, requiring catheterization. The condition is fairly rare, about 200 cases having been reported

in the literature but there are probably a large number of cases that have never been reported. Priapism may occur throughout life in infancy and in old age. The erection may have persisted for several months at the time of admission. The penis may show ulceration. Classification of the causes of this condition have been made by Scheuer⁴¹ Hinman⁴² and others. Hinman divided the causes into nervous and local mechanical. As an example of nervous causes one might mention spinal syphilis, injuries and diseases of the spinal cord and brain tumors. Of the local mechanical conditions one may mention inflammations of the urethra which extend to the corpora cavernosa, injuries in this region and tumor growths affecting the corpora as have been reported by Kessell⁴³ Irontz and Alvea⁴⁴ and others. Priapism is associated with general diseases such as leukemia, gout and general infections, yellow fever, malaria, tuberculosis, etc. McKay and Coleston⁴⁵ have pointed out that irrespective of whether the initial erection was due to neurological conditions or local conditions or systemic diseases, that if it had persisted for two days or more there existed a thrombosis of the corpora which in itself was sufficient to sustain the erection. Therefore, even if one succeeded in treating the underlying cause, the erection would persist until the clot in the corpora had been disposed of either by absorption or evacuation. Surgical evacuation of the clot from the corpora according to Berkley⁴⁶ was done by Calloway⁴⁷ as early as 1821. McKay and Coleston have recently introduced a procedure of aspirating the corpora cavernosa with a 20-cc. Luer syringe, being careful to avoid the deep artery of the corpora. A needle is introduced on the lateral dorsal aspect of the penis and the clotted blood aspirated. On account of the free anastomosis between the corpora, both corpora may be aspirated by the puncture of one of the corpora only. The corpora are then washed out with saline solution. They recommend the repetition of the aspiration if necessary. Having relieved the priapism, every effort should be made to determine the underlying cause. Blood studies should be made for leukemia, neurological studies should be made for diseases of the nervous system, roentgen rays should be made for any injuries of the vertebra, blood and spinal Wassermann test should be made and in fact a most careful general examination carried out.

Gumma.—Gumma may be found in any part of the penis. The masses have a tendency to break down. The lesions are not associated with pain.

Skin Affections of the Penis.—The penis is the subject of many skin conditions among the most frequent of which are scabies, psoriasis, leukoplakia, etc. These lesions together with many others have been very fully described by Diasio⁴⁸ to whose contributions I would refer.

In this chapter I have not considered the very important ulcerative lesions of the penis, namely, chancre, chaneroid, granuloma inguinale, and erosive and gangrenous balanitis, as these are treated extensively in another part of this work.

by inhalation. Microscopically one finds a fine, branching mycelium which is Gram-positive when young, but later small Gram-positive granules make their appearance in the mycelial threads and the remainder becomes Gram-negative. Finally the threads break into short bacillus-like rods, which may be Gram-positive or Gram-negative, and into small, round, coccus-like bodies, always Gram-positive. The organisms may thus take the form of a mycelium, a bacillus or a coccus. From the very nature of things actinomycosis of the penis must be extremely rare. In a study made by Hill and Cecil on primary genito-urinary actinomycosis, no penile lesions were found. Leger⁵³ has reported a case with a skin lesion on the glans penis. According to Diaio,⁵⁴ in these cases the glans is indurated, covered with many small purulent knotty masses, punctured by small holes from which a sero-anguineous secretion exudates. Pain is an early concomitant. The ray fungus can be demonstrated in the secretion. The treatment of actinomycosis is unsatisfactory and the prognosis is bad. Iodides have been recommended. Wide surgical removal, if possible, would seem to be the best form of treatment.

Preputial Calculi.—Joly⁵⁵ in his work on calculus diseases of the urinary tract has described the occurrence of preputial calculi. He states that stones have been found as large as a hen's egg in a boy, aged eight years, and as large as a clenched fist in adults. Stones in this region, associated with marked balanoposthitis, present a foul-smelling and occasionally bloody discharge from the preputial sac. Urination may be difficult. Preputial stones are always secondary to phimosis and, according to Joly, three types are found. Those that are formed by lime salts being deposited on epithelial cells and smegma of the preputial sac, those that are made up as urinary calculi from stagnant decomposing urine in the preputial sac. These are usually composed of ammonio-magnesium phosphate and calcium phosphate, but many contain oxalates, etc., and a third type, which are migratory stones originating either in the kidneys or bladder and caught in the phimotic preputial sac. The treatment consists in circumcision. Joly points out that before doing a radical operation for carcinoma of the penis that the prepuce should be split open for exploration, as the indurated mass may be due to preputial calculi rather than carcinoma.

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CHAPTER VI

GENITAL ULCERS.

By B C CORBUS, M D , F A C S

Historical Review.—The Bible is the most ancient as well as most reliable source from which early knowledge in regard to genital ulcers can be obtained. The plague which fell upon the men who frequented the altars of Baal is supposed to relate to ulcerations of the penis, while the lamentations of King David over the sharp pains in his bones doubtless refer to the effects of venereal disease. Changes in the throat and soft palate are mentioned by St. Paul in his epistle to the Romans. From all these it is fair to infer that genital ulcers with their accompanying effects existed in ancient days.

Hippocrates, among the early medical writers, speaks of ulcerations of the genital organs, of tumors of the groin, of ulcerations of the mouth, and of extensive pustular eruptions on the body. Later, Celsus describes two varieties of ulcers on the penis, which he calls “*ulcera sicca*” and “*ulcera humida*.” This division fits admirably well the description of today—the soft chancre, which suppurates freely, and the hard, which scarcely suppurates at all. Celsus also describes the phagedena which may invade the ulcers at times. Aretaeus describes the destruction of the uvula and soft palate. Cribasius, like Celsus, divides the ulcers into dry and moist. Galen speaks of ulcers of the scrotum, which he divides into two classes, deep and superficial. Aretaeus and Paul of Aegina both make mention of ulcerations of different kinds that develop on the genital organs.

According to Pusey¹ “There is thus an accurate historic record of the startling spread of syphilis over the known world in a few years after 1494, for this disease no name existed and a new one invariably had to be invented. No similar record exists of the sudden establishment of any other great disease among the larger part of the earth’s inhabitants.” He states further “that in all mediæval and ancient literature, there is no certain reference to a disease of the genitals which is commonly followed by general manifestations.”

Oviedo (1478–1557) was in Barcelona at the time of the return of Columbus in 1493, and he knew him and members of his crew. In his *Historia general y natural de las Indias*, and in a report drawn up at the command of Charles V of Spain, he recited that the disease was contracted from Indian women by the Spaniards with Columbus, that it was brought by them to Spain and thus transmitted to the army of Charles VIII by Spanish soldiers.” So we are led to infer that the biblical references to what was supposed to be syphilis must have been to some other morbid condition.

The cases became so numerous in Seville that special hospitals were

opened to cope with the situation. During 1494 the whole of Italy was infected progress being noted from town to town.

In 1495 France, Germany and Switzerland became the seats of virulent outbreaks. Holland and Greece in 1496, England and Scotland in 1497, and Russia and Hungary in 1499. In 1496 the Decree of the Parliament of Paris required all infected persons to leave the city. Outbreaks were reported in Scotland during Cromwell's time in the seventeenth century, in Norway in 1720, in Prussia in 1757, in Sweden in 1762, in Holland in 1789 and in Uganda (Africa) in 1896.

At present syphilis exists everywhere in the world, being less frequent in the rural districts and most frequent in the large cities.

No historical sketch, however brief, should close without a reference to John Hunter and Philippa Ricord. In 1767 John Hunter inoculated himself on the prepuce and glans with the pus from a virulent gonorrhoea and produced a chancre as well as constitutional syphilis. From this he concluded that the secretion from a case of gonorrhoea was capable of producing all three diseases, gonorrhoea, chancreoid and syphilis.

This unfortunate theory was not disproved until the masterful Ricord by his careful and unbiased observations and researches showed the different clinical entities of gonorrhoea, syphilis and soft chancre.

During the last three decades there has been a tremendous advance in our knowledge of syphilis. The discoveries of Metchnikoff and Roux, Schaudinn and Hoffmann, Bordet and Gengou, of Wassermann, Neisser and Bruck, Ehrlich and Noguchi mark milestones in our progress toward the eradication of this universal disease.

Classification.—Genital ulcers are divided into two classes:

A. Venereal genital ulcers.

B. Non venereal genital ulcers.

A. Venereal genital ulcers which may be classified in the order of their importance as follows:

1. Syphilis.

(a) Chancre.

(b) Ulcerated papule.

(c) Gumma or chancre redux.

2. Erosive and gangrenous balanitis.

3. Chancreoid.

4. Granuloma inguinale.

5. Lymphogranuloma inguinale.

1 SYPHILIS

FIRST VENEREAL DISEASE

(a) **Chancre**—**Synonyms.**—Primary sclerosis, initial lesion of syphilis, hard chancre, Hunterian chancre, *ulcus durum*.

Definition.—A true syphilitic chancre may be defined as the initial syphilitic lesion formed at the point of inoculation and the first known collection of spirochetes.

Etiology — *Predisposing Causes* — (1) Alcohol, (2) venereal excesses, (3) promiscuous sexual indulgence

Exciting Causes — The *Spirochæta pallida* of Schaudinn and Hoffmann

Characteristic Features of the Spirochæta pallida as Observed with the Dark-field Condenser — The spirochetes when examined with the dark-field condenser are much more typical than in the stained specimen and are exact duplicates of tissue specimens stained by the Levaditi method. The most characteristic features are

1 *Size* — They vary in length from 7 to 21 microns, being from one to three times the diameter of a red blood cell. It is not uncommon to see the organism longer than this, but on account of the difference in the motions of the two extremities it is possible that these long forms are composed of two or more organisms

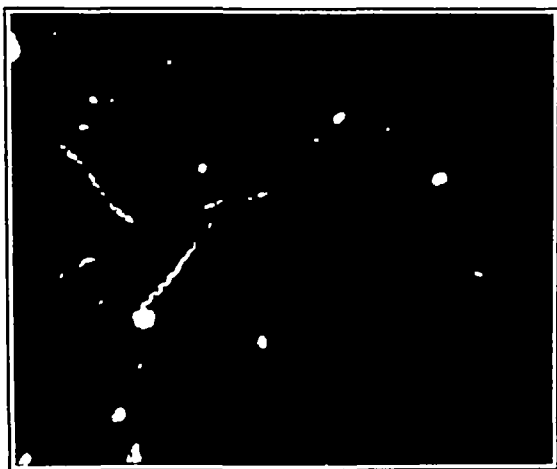


FIG 118 — Microphotograph *Treponema pallidum*. Dark-field view of an expressed specimen (serum) from a chancre. $\times 1100$. These are identical with the Levaditi-stained spirochetes as shown in Fig. 127.

2 *Shape* — They are seen to consist of an extremely slender thread closely wound in a corkscrew or spiral spring form, the windings being very acute. In the fresh specimens the windings are absolutely regular, but as the specimen gets older the organism changes form, the most frequent change being an obliteration or irregularity of the windings in the central portion. This is a very common appearance in the stained preparations.

3 *The Ends* — These are sharp and terminate on the periphery of the spiral and not in the center, as the *Spirochæta buccalis* and some of the other forms do. This peculiarity of the ends is seen only when the organism rotates on its long axis.

4 *Motility* — When the specimen is freshly prepared the organism is very active and possesses the following motions. (a) A rotation on its long axis in either direction, this motion is very rapid, but not necessarily accompanied by change of position, as the specimen becomes older this motion grows less. (b) It progresses from place

to place but not so rapidly as the other forms of spirochetes commonly encountered (c) They have a bending or twisting motion which is quite quick and spasmodic. This bending movement increases as the specimen ages and at times an organism is seen bent in the form of a circle resembling somewhat a crenated red blood corpuscle. It is not uncommon to find two organisms joined end to end.

Histology and Pathology — The abundant discharge from a fresh specific primary lesion if untreated contains a large number of spirochetes but if examined before the lesion has broken down their demonstration may be difficult unless gentle scarification and cupping are practiced.



FIG. 119 — Chancre of penis (low power). Shows moderately advanced lesion blood vessels much increased with walls thickened. Marked proliferation of endothelial leukocytes into walls of vessels, causing endarteritis. In the connective-tissue stroma erudate is marked, consisting of polymorphonuclear leukocytes and plasma cells. (Author's case.)

The spirochetes are irregularly distributed in the foci which accounts for failure at times to demonstrate the organism after the Lavaditi method. This more or less irregular distribution of the spirochetes occurs more particularly in fresh lesions. As the spirochetes are responsible for the periarteritis and endarteritis they are found most abundantly in tissues immediately surrounding the blood vessels, in the walls of the vessels themselves in the lymph spaces and in the Malpighian bodies (Figs. 119 and 120).

The initial sclerosis shows in the early stages a lymphocyte and plasma-cell infiltration around the blood and lymph vessels in the depth of the cutis and the papillary bodies. Gradually the lumen of

the blood-vessels becomes widely distended, there is swelling and proliferation of the endothelium and formation of new capillaries. Inflammatory changes and proliferation occur in the tissues surrounding the vessels. This congestion and proliferation of the capillaries increases, the vessels become thrombosed, resulting in destruction of the vessels and a degeneration of the cellular exudate. Gradually the epithelium covering the lesion shrinks and becomes necrotic, while the papillæ in the vicinity of the erosion become enlarged and the infiltration extends out over the ulcer onto the surrounding epithelium, both laterally and deeply, later more extensive inflammatory changes result in and about the arteries, veins, and lymph vessels. There is an increase of yellow elastic fibers.

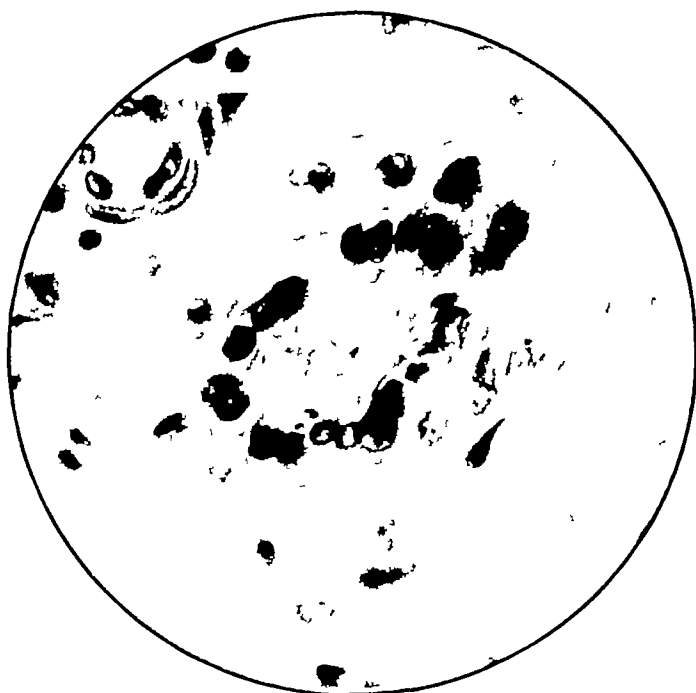


FIG. 120 —Chancre of penis (high power). Shows wall of blood-vessel infiltrated with many endothelial leukocytes.

It is this condition which constitutes the specific induration, and the amount of induration will depend on the depth of the vessels which are affected.

Incubation —The period of incubation is from ten to twenty-eight days (exceptional cases longer), most frequently from fourteen to twenty-one days.

Classification A Anatomical B Clinical

A ANATOMICAL CLASSIFICATION —The location of the primary lesion depends on the site of contact and inoculation and may be anywhere on the genitals, *i. e.*, scrotum, labium, urethra, glans penis, etc.

B. CLINICAL CLASSIFICATION

1. Chancreous erosions.
2. Chancreous ulceration superficial and deep
3. Indurated papule

A chancre is not auto-inoculable after ten days but may be so before. It is, as a rule, single (single point of contact) but may be double or multiple (multiple point of contact). The author has had the opportunity of observing a case in which there were five lesions arranged around the glans penis, somewhat resembling a collar in each of which spirochetes were demonstrated.

1. *Chancreous Erosions* — After variable periods of incubation depending on the virulence of the spirochete and the receptiveness of the host the chancre manifests itself. At first there is a hyperemic area, this later becomes a superficial papule and still later, through its inherent pathology, slight traumatism and mild secondary infection, becomes a superficial erosion thus marking the beginning of the chancre. A common form seen is a "small abrasion" and on account of its insignificant appearance is most frequently permitted to go undiagnosed for some time.

Induration as a rule is very slight or entirely absent. Later this erosion enlarges, becomes a deeper red and may pass into the following.

2. *Chancreous Ulceration Superficial and Deep* — The superficial erosion rapidly extends in breadth and depth. Induration is the rule and may be marked but is always superficial at first. The ulcers are dusky red, circular and slightly cup-shaped with smooth slanting walls. A false membrane may be adherent over the lesion and slight irritation causes an abundant exudation of serum. Later the induration extends deeper, the ulcer destroying the true skin as well as the tissue beneath it.

3. *Indurated Papule* — In this form the lesion occurs where the integument is thick, it retains its papular form and may attain large dimensions 0.5 to 2.5 cm. in diameter, its surface remains intact and as a rule there is little excretion.

Morton² says: "The forms of the chancres differ depending on the anatomical part on which they are located and also on the course and situation of the blood vessels.

"When they run horizontally and near to the surface a thin flat layer of infiltration occurs under the skin which is called *parchment induration*. On the other hand when the blood vessels dip down deeply into the tissues the induration is extensive and deep and is called *Hunterian induration* (Figs. 121 and 122).

For example inside the prepuce the *parchment chancre* often occurs in the sulcus coronarius, a heavy mass of infiltration takes place forming a Hunterian chancre. In the frenulum a thick cord occurs and on the glans a flat erosion.

Pain — All primary lesions are characterized by their lack of discomfort, both local and constitutional unless complicated by a mixed infection or situated where there is continually a change of its base

(urethral chancre) Inflammation, except over the site, is usually slight, the patient's attention being first drawn to the condition by stinging and burning, as if he had been bitten by a fly or some small insect



FIG 121 —Typical Hunterian chancre (Author's case)



FIG 122 —Same as Fig 121, twelve days after injection of 0.5 gm arsphenamine (Author's case)

In careless, slovenly persons a chancre may attain large proportions before it is noticed

In most chancres an abundant exudation of serum can easily be provoked by gentle irritation or cupping this being due to the abundant vascular supply.

Diagnosis.—So rapid and exact have become our methods of diagnosis in primary lesions that the physician who fails to avail himself of these accurate and specific diagnostic methods should be held responsible.

Many physicians seeing a lesion for the first time thoughtlessly prescribe a little dusting powder while all the time the organisms of syphilis are multiplying and daily the possibility of a speedy cure lessens.

A favorite dusting powder for genital ulcers is calomel. When dusted on a lesion it temporarily destroys the spirochetes *in situ* and it may be several days before all the powder can be removed in the meantime the disease slowly progresses. Occasionally puncture of the inguinal glands will reveal the organism but this is not an easy procedure.

The safest method for the patient and his physician is to treat all ulcers in the light of a specific origin—apply no treatment whatever and permit no mutilation in the way of cauterization until it has been thoroughly demonstrated by a careful laboratory worker that syphilis does or does not exist. The removal of sufficient clothing to permit a thorough examination of the body should be insisted on. Often the clinical picture at the secondary period is so pronounced that added laboratory findings are only confirmatory however in the primary stage without laboratory confirmation one should not feel safe in making a positive diagnosis.

The Dark-ground Illuminator—This method was described by the Rev J B Read in 1837. He used practically the same apparatus that we are using today. Read described his method just at the time that Professor Abbe brought out his well known substage condenser and in the excitement over Professor Abbe's invention the dark ground illuminator was forgotten until rediscovered by Reichert the microscope manufacturer of Vienna in 1907.

The advantage of this method depends on the illumination the principle of which is the same as that causing dust particles to become visible when passing through a beam of sunlight.

The apparatus of Reichert consists of a metallic plate having a hole in the center above which is fitted a piece of glass having a circular excavation on its under surface. The sides of this excavation are ground at a certain angle and silvered. By means of a revolving disk different-sized diaphragms are used to cover the central part of the excavated area so that when the light is reflected up from the plane mirror of the microscope only the marginal rays reach the glass plate. These impinge on, and are reflected by the silvered sides of the excavation to a central point 1 mm above the surface of the glass plate. Any solid body here will intercept these rays and appear as luminous objects on a dark ground. By this method it is possible to see the particles of colloidal substances in their solutions (Figs. 123 and 124).

The Reichert Instrument — A form of dark-ground illuminator is now manufactured by most of the microscope makers, but the Reichert instrument is superior to others for the following reasons

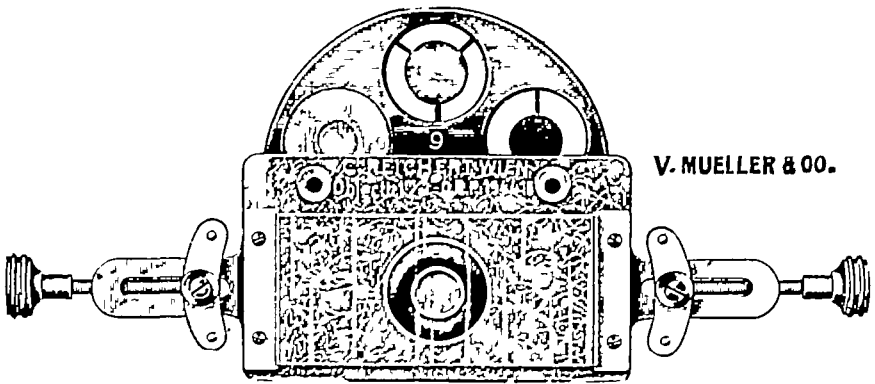


FIG 123 —The Reichert apparatus for "dark-ground" illumination, to be attached to the microscope stage

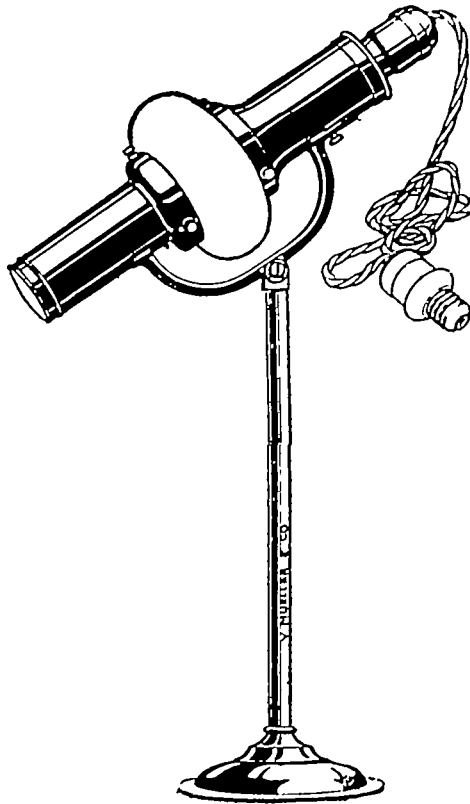


FIG 124 —Nernst lamp For use with the Reichert dark-ground illuminator

- 1 It can be used on any kind of microscope
- 2 The light may be varied at will, by means of the revolving diaphragm

3. It is possible to change from the dark ground method to the ordinary method of transmitted light merely by revolving the diaphragm.

The method of using the apparatus is as follows:

The Abbe condenser is removed. A strong light is necessary—one may use the sun, an arc light, a Nernst lamp, or an inverted Welsbach. With the inverted Welsbach, a six inch condenser lens is necessary, or a large glass globe filled with water serves the same purpose. The illuminator is placed on the stage of the microscope, and by means of the low power the circle which is etched on the glass plate is brought into the center of the field and the apparatus fixed in this position by means of the clips of the microscope. A drop of immersion oil, free from air bubbles, is placed on the center and the prepared slide put in place, great care being taken to avoid the formation of air bubbles. When the preparation is examined with the low power, if the light is placed correctly and the apparatus centered, a bright central point will be observed. The high power is then turned on and the field is seen to be dark, with luminous points and bodies.

Preparation of the Materials—The method of preparing the specimen is very important. The slide must be 1 mm. thick and both slide and cover-glass must be perfectly clean and well polished, as any turbidity or scratches disperse the light and cause annoying halos, which prevent the dark-ground effect and interfere with the examination. Air bubbles in the specimen also cause these disturbing effects. The specimen must be as thin as possible. The observation is best made with a dry system. The author uses a Laitz 1 inch objective and a No. 5 ocular. An oil immersion can be used in this case, however, it is necessary to diminish the aperture of the objective by inserting a truncated cone back of the front lens of the objective. This cuts out the diverging rays of light, which otherwise would flood the field. For diagnostic purposes it is seldom necessary to use the oil immersion.

Method of Obtaining the Material—For chancre (Fig. 125) it is sufficient to clean the lesions thoroughly with warm water. They are then irritated by being rubbed gently with a piece of cotton wrapped on a probe, thus causing an abundant exudation of serum. This is collected by means of a capillary pipette as shown in Fig. 125. A small drop of this is placed on a cover glass, which is now carefully inverted on the slide as in making a fresh blood preparation. It is well not to have much admixture of blood, as the blood cells interfere somewhat with the observation.

On looking at a specimen containing serum from a chancre, numerous small round luminous bodies are seen, which have a very active Brownian movement. These particles of albumin are probably identical with the blood dust of Müller. If the cleansing has not been thorough, various forms of bacteria are often seen, the cocci looking like pearls. The leukocytes are seen as a mass of white granules surrounding the dark nucleus, the various forms being easily differ-

2 Wash in water and transfer to alcohol (96 per cent) for twenty-four hours

3 Wash in distilled water until the pieces of tissue fall to the bottom of the jar

4 Impregnate for from three to five days at 38° C in a 2 per cent solution of silver nitrate in the dark

5 Wash in water and reduce overnight at room temperature in the following bath

Acid pyrogallie	1 gm
Formalin	5 cc
Water, distilled	91 cc

6 Wash in water, dehydrate, and embed in paraffin in the usual way

7 Cut the sections not thicker than 5 microns and mount in Canada balsam. No further staining is required, though Levaditi has recommended counter-staining with toluidin blue, neutral red or Giemsa's solution

Levaditi and Mamouelian's Rapid Silver Method—Levaditi recommends this method for staining tissues which have been removed during life, or immediately after death

1 The tissue is cut and fixed as in the previous method

2 Impregnate in the following solution for twelve hours at room temperature, and then for five or six hours at 55° C

Silver nitrate solution, 1 per cent	90 cc
Pyridine	10 cc

3 Wash in water and reduce in the following solution overnight

Pyridine	17 cc
Acetone	10 cc
Acid pyrogallie (1 per cent)	90 cc

4 Dehydrate, and embed in paraffin in the usual way

5 Cut sections not thicker than 5 microns

The India-ink method of Burr, while recommended as short and reliable, is a poor makeshift. The demonstration of the spirochetes is complicated by too many artefacts (Fig 128)

Although a wonderful advancement has been made in the treatment of syphilis, comparatively few realize the role that the early diagnosis plays in the cure of the patient

Many staining methods for the detection of the spirochete have been recommended as short and reliable, but none has as many advantages as the dark-field condenser, as here the demonstration of the living spirochete is characteristic and distinct. From an experience dating from the year 1908, consisting of many hundreds of examinations, the author considers that the one and only method for use is the dark-field condenser. The advantages of this method depend on the illumination, which is greatly facilitated by the new Neimst lamp. This style of lamp has an advantage over the arc light, in that it gives

a continuous, strong light with no breaking or closing of the circuit or burning out of carbons

Noguchi's method of snipping out a small piece of the lesion and macerating it with salt solution in a mortar offers an excellent way of obtaining the organism in large quantities for in this manner they are expressed from the lesion and appear abundantly

The universal procedure of making a smear from a lesion just as one would do in making an ordinary pus smear should be emphatically condemned as it is absolutely impossible for the laboratory in this way to do itself justice

The Wassermann Reaction—Frequently the Wassermann reaction is resorted to as a final word in diagnosis. It must be distinctly understood that the Wassermann test cannot be relied on at the period of primary invasion that the reaction is positive in direct proportion to the time of the presence of the primary lesion that the reaction is nearly always negative until about three weeks after the first appearance of the sore and after that period it is invariably positive



FIG. 12b.—Microphotograph of *Treponema pallidum* from chancre. Burri's India-ink method. $\times 1600$ (Author's case)

However during the presence of the primary lesion there are two things that we wish to know namely (1) the result of the Wassermann reaction on the blood as a biological guide to future treatment and if this should prove to be positive (2) the result of the spinal fluid examination as a control on future complications of the nervous system. The spinal fluid should not be examined until at least three months have elapsed during which continuous treatment has been instituted

1 Wassermann Reaction on the Blood—For example a patient presents himself for examination. Diagnosis is made by finding the spirochete in the primary lesion. Assume that the Wassermann examination is negative. This shows that the system is not involved to any great extent and the possibilities of a speedy cure are good. On the other hand take a similar case in which the diagnosis is made by finding the spirochetes in the primary lesion, but with the Wasser-

2 Wash in water and transfer to alcohol (96 per cent) for twenty-four hours

3 Wash in distilled water until the pieces of tissue fall to the bottom of the jar

4 Impregnate for from three to five days at 38° C in a 2 per cent solution of silver nitrate in the dark

5 Wash in water and reduce overnight at room temperature in the following bath

Acid pyrogallie	4 gm
Formalin	5 cc
Water, distilled	91 cc

6 Wash in water, dehydrate, and embed in paraffin in the usual way

7 Cut the sections not thicker than 5 microns and mount in Canada balsam. No further staining is required, though Levaditi has recommended counter-staining with toluidin blue, neutral red or Giemsa's solution

Levaditi and Mamouelian's Rapid Silver Method—Levaditi recommends this method for staining tissues which have been removed during life, or immediately after death

1 The tissue is cut and fixed as in the previous method

2 Impregnate in the following solution for twelve hours at room temperature, and then for five or six hours at 55° C

Silver nitrate solution, 1 per cent	90 cc
Pyridine	10 cc

3 Wash in water and reduce in the following solution overnight

Pyridine	17 cc
Acetone	10 cc
Acid pyrogallie (4 per cent)	90 cc

4 Dehydrate, and embed in paraffin in the usual way

5 Cut sections not thicker than 5 microns

The India-ink method of Burri, while recommended as short and reliable, is a poor makeshift. The demonstration of the spirochetes is complicated by too many artefacts (Fig 128)

Although a wonderful advancement has been made in the treatment of syphilis, comparatively few realize the role that the early diagnosis plays in the cure of the patient

Many staining methods for the detection of the spirochete have been recommended as short and reliable, but none has as many advantages as the dark-field condenser, as here the demonstration of the living spirochete is characteristic and distinct. From an experience dating from the year 1908, consisting of many hundreds of examinations, the author considers that the one and only method for use is the dark-field condenser. The advantages of this method depend on the illumination, which is greatly facilitated by the new Nernst lamp. This style of lamp has an advantage over the arc light, in that it gives

Technique of Leukocyte Count of Spinal Fluid — The Turek apparatus is employed. The spinal fluid to be tested is thoroughly shaken. Draw up in the white-cell counting pipette 10 per cent acetic acid to the mark I then the spinal fluid to the mark II. This gives an employment of 9 parts of spinal fluid to 10 parts of the mixture or $\frac{9}{10}$ of the mixture is spinal fluid. Blow out the first few drops of the solution from the pipette and then place on the chamber just sufficient fluid so that with pressure of the cover-glass Newton's rings appear at the four corners. Count the cells in the whole ruled area. This space contains 0.9 c mm. of fluid. Since the mixture is $\frac{9}{10}$ spinal fluid and $\frac{1}{10}$ diluting fluid the number of cells counted $\times \frac{10}{9} \times \frac{1}{0.9} =$ the number of cells per c mm. For example if the 0.9 c mm. contains 40 cells then the cell count is $40 \times \frac{10}{9} \times \frac{1}{0.9}$ or 49. If cells are so numerous as to cause clouding, the spinal fluid must be diluted as for a leukocyte count of the blood.

3 **Globulin** — This test may be made after the method of Noguchi or the method of Nonne-Apelt.

Technique of the Noguchi Butyric Acid Test — To 0.2 cc. of spinal fluid add 0.5 cc. of 10 per cent butyric acid in physiological salt solution. Boil carefully over a small flame for one minute and add quickly 0.1 cc. of normal sodium hydrate and boil again for a few seconds. In the presence of excess globulin a precipitate forms of varying intensity depending on the amount of globulin present. A cloud may appear in normal fluid.

Technique of the Ross-Jones Modification of the Nonne Test — Float on top of about 0.5 or 1 cc. of supersaturated (by heat) ammonium sulphate solution about one-half the quantity of spinal fluid. In the presence of excess globulin a white ring forms. In case of a small quantity of globulin if the ring is either absent or indistinct shaking the tube will cause the clouding to become prominent.

4 **Pressure** — Pressure is estimated by allowing the fluid to run into a graduated manometer tube with a bore 3 mm. in diameter and reading the height to which the fluid rises. This figure is only relative.

Necessity for Spinal Fluid Examination in Syphilis — Ever since the discovery of Noguchi⁶ that the cerebrospinal fluid in paresis, cerebrospinal syphilis and tabes contains active spirochetes which are capable of being transmitted to animals a new light has been thrown upon subarachnoid involvement. How this involvement takes place is not exactly known whether the spirochetes are capable of passing through the choroid plexus, or advancing along the lymphatics that accompany the nerves. Future investigation will have to determine.

There is little doubt as Mott⁷ has already shown that there is a selective type of organism that has a predilection for the nervous system.

Differential Diagnosis — Notwithstanding the many newer diagnostic methods that are in vogue clinical symptoms should be carefully noted and the laboratory reports carefully checked up especially since there are so many laboratories whose reports are conflicting.

mann examination positive This shows a considerable systemic invasion and is not so favorable for a speedy cure

It is not generally recognized that the consumption of even small quantities of alcohol, if taken from one to seven days before the Wassermann test is made, tend to influence the test by producing a false negative reaction Attention was first called to this by Craig and Nichols,³ of the United States Army, and since then it has been verified by serologists generally

2 *Spinal Fluid Examination* —During the past seven years, numerous observers, both in this country and abroad, have called attention to the fact that the nervous system is already involved in early syphilis, a thing almost undreamed of before this time This involvement seems to be due to a selective type of spirochete, and it becomes our duty to puncture the spinal canal in those cases in which a strong positive Wassermann reaction is obtained, if we wish to control the situation here as well as in the blood stream However, spinal puncture should never be performed during the period of secondary invasion lest, in the replacement of the spinal fluid drawn out for diagnosis, spirochetes might be drawn into the subarachnoid space

The spinal fluid examination consists of the following

- 1 Wassermann reaction
- 2 Cell count
- 3 Globulin reaction
 - (a) Noguchi
 - (b) Nonne-Apelt
- 4 Pressure

Technique —Lumbar puncture is always performed best with the patient lying on his side It is essential to obtain at least 8 cc of fluid for a proper examination While it was previously advisable to perform the puncture in a hospital, it is now no longer deemed necessary If a small needle is used and the patient is permitted to rest for at least an hour, there should be no untoward effects However, in spite of all precautions there at times occurs a troublesome headache which is relieved only by having the patient lie absolutely flat without a pillow

1 *The Wassermann Reaction* —Of all the tests, the Wassermann reaction on the spinal fluid is the most reliable Frequently, however, an error has been made in taking too small a quantity of this fluid, at least seven times the quantity that is required for the blood Wassermann test is absolutely essential for accurate results

2 *Cell Count* —The following standard of Dreyfus,⁴ based on 750 punctures, is recommended by Ellis and Swift,⁵ of the Rockefeller Hospital

- 1 to 5 cells per c mm.—Normal
- 6 to 9 cells per c mm —Doubtful, border cases
- 10 to 20 cells per c mm —Slight lymphocytosis
- 21 to 50 cells per c mm —Moderate
- Over 50 cells per c mm —Marked

STANDARD SYPHILIS TECHNIQUE NUMBER 1

Case No. Name
 EARLY PRIMARY SYPHILIS (Blood Wassermann positive)
 SYPHILIS (Blood Wassermann negative)

BLOOD WASSERMANN Date Finding
 When giving reaction state whether none-mild-moderate-severe Regulate Arspenamine dose to weight of patient 1 decagram for each 30 lbs. of body weight.

ARSPENAMINE ONCE WEEKLY FOR SIX WEEKS

1ST WEEK	2ND WEEK	3RD WEEK	4TH WEEK	5TH WEEK	6TH WEEK
Date Reaction	Date Reaction	Date Reaction	Date Reaction	Date Reaction	Date Reaction

MERCURY RUBS FOR FOUR WEEKS-PATIENT SHOULD CALL WEEKLY FOR OBSERVATION.

7TH WEEK	8TH WEEK	9TH WEEK	10TH WEEK	11TH WEEK	12TH WEEK	13TH WEEK
Date Reaction	Date Reaction	Date Reaction	Date Reaction	Date Reaction	Date Reaction	Date Reaction

ARSPENAMINE INJECTIONS ONCE WEEKLY FOR 2 WEEKS

14TH WEEK	15TH WEEK	16TH WEEK	17TH WEEK	18TH WEEK	19TH WEEK
Date Reaction	Date Reaction	Date Reaction	Date Reaction	Date Reaction	Date Reaction

MERCURY RUBS FOR 4 WEEKS*

20TH WEEK	21ST WEEK	22ND WEEK	23RD WEEK	24TH WEEK
Date Reaction	Date Reaction	Date Reaction	Date Reaction	Date Reaction

ONE INJECTION ARSPENAMINE

BLOOD WASSERMANN Date Finding
 Make Blood Wassermann at end of course. If Blood Wassermann is positive treat as latent syphilis, (card 5.) If Spinal Fluid Wassermann is positive treat as neuro-syphilis, (card 7.) If both are negative discontinue treatment.
 DISCHARGE TECHNIQUE. Negative Blood Wassermann every (our months for one) year after treatment has stopped.

This system was developed by D. B. C. O'Brien, Chicago
 Or this can be substituted for by the bi-weekly injection of soluble salt of Lanthanum.
 Published by J. B. Lippincott, Inc. and Co. Chicago
 Illinois Social Hygiene League Chicago

Scabies — Occasionally there occurs on the glans penis an isolated area of scabies. If the surgeon will take the trouble to have the patient remove his clothing, as a rule, numerous evidences of this parasitic affection can be found on other parts of the body. There is no period of incubation, and microscopical examination for spirochetes is negative. The condition remains as a papule with no inguinal adenopathy, itching is a prominent symptom, especially after retiring at night.

(For further information see B. Non-venereal Genital Ulcers at the close of this chapter. See Table 1 for the differential diagnosis between syphilitic chancre, chancroid, herpes and erosive and gangrenous balanitis.)

Prognosis — The prognosis in all uncomplicated luetic lesions is excellent, but to say that every case with its attending systemic infection can be cured is just as foolish as to say that no case can be cured. The curability of syphilis depends on making a prompt diagnosis, for the earlier a patient comes under observation, the easier it is to effect a cure. That the biological method offers the best means of controlling the treatment of the disease there can be no question. Unfortunately, the tendency is to give too little treatment.

Prophylaxis — The use of a condom during sexual relations is perhaps the best safeguard against infection. Metchnikoff's calomel ointment (calomel 20, lanolin 40), if used up to within one hour after exposure, has proved a reliable preventive in the army and navy, but after four hours its efficacy is lost. As reliable substitutes, mercurettes (Parke, Davis & Co.) and 50 per cent mercury ointment may be used. In 1913, Schereschewsky⁸ proved experimentally on apes that 40 per cent quinine is safe and efficient, if applied after the same method as the mercury ointment.

As the primary lesion is only a local manifestation of a general infection, the treatment may be divided into local and systemic.

Local Treatment — No treatment, either general or local, should be instituted before a positive diagnosis is made.

Excision of the Chancre — As the initial lesion of syphilis is the first-known collection of spirochetes, Lukasiewicz, Jadassohn,⁹ and others declare that if excision of the chancre is done before the second period of incubation, the infection is attenuated. It is reasonable to suppose that if there is a large area that is constantly feeding the system with infecting organisms, that area should be removed, especially since its removal does not entail any serious effects on the patient. Whenever it is at all possible, without undue loss of tissue, the chancre should be excised. In those cases in which the lesion is so situated that its removal would cause extensive destruction of tissue, one should be satisfied with thorough cauterization and curettement and the free use of calomel. In cases in which either excision or curettement would cause a troublesome scar (urethral chancre), calomel dusting powder should be used.

General Treatment — As soon as the diagnosis of a specific infection is established, systemic medication should be resorted to (within the

Next the normal sodium hydroxide solution is added (about 2 cc.) and shaken thoroughly. A precipitate occurs. Then sodium hydroxide solution is added drop by drop the solution being shaken after each drop until it is absolutely clear care being taken not to add an excess. Next distilled water is added up to 200 cc. The whole is then filtered into the receptacle which accompanies the intravenous apparatus. Here the outlet is in the side of the cylinder slightly above the bottom forming a little receptacle that holds any foreign material that may

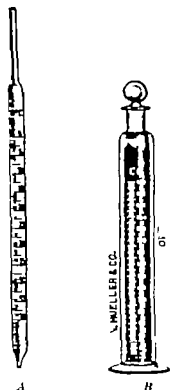


FIG. 120 —Graduated pipette (A)
Large 250 cc. cylinder (B)

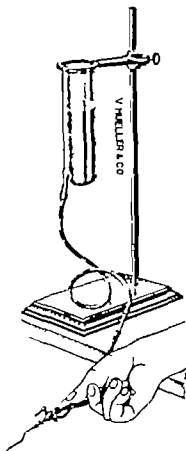


FIG. 140 —Corliss intravenous apparatus.

get into the cylinder thus ensuring the injection of a more perfect solution. It is not necessary to use normal saline solution as the above solution is very nearly isotonic.

The arm is thoroughly scrubbed and a constrictor placed above the elbow. After it has been made certain that the solution runs through the tube and needle easily that it is not above 98.6 F. and that air bubbles are absent the needle is thrust into the vein great care being used not to puncture the vein except to enter its lumen for any of the solution that is injected elsewhere than in the vein will produce a marked paraphlebitis. With the two-way cock attachment, it is easy

next five minutes, if possible) No time should be lost, as every minute is valuable Either arsphenamine or mercury should be given at once The plan that the author has adopted is to give 10 m of 2 per cent solution of cyanide of mercury intramuscularly at once, and as soon as possible, preferably within the next two hours, a half dose of arsphenamine or neoarsphenamine intravenously

Status of Arsphenamine in 1936—Notwithstanding that deaths have occurred both in this country and abroad following the use of arsphenamine, and notwithstanding differences of opinion regarding its value and toxicity, the author believes it still remains the most powerful spirillicide that we possess If used with discretion and judgment, it is the most valuable single weapon we have in combating the infection, and if it is administered in small doses, not to exceed 0.3 gm once in seven to ten days, the author believes there are no contra-indications That the substance is neither harmful to the nervous system nor kidneys has been proved by Doinikow¹⁰ and Wechselmann¹¹

Unquestionably the fatalities and complications laid at the door of arsphenamine are due to errors in technique Briefly and in order of their frequency these errors are

- 1 Use of water that contains saprophytic bacteria
- 2 Oxidation of the drug
- 3 The question of whether the solution is hypotonic or hypertonic

Considering the wide use of arsphenamine, it is safe to say that many doses are given with water that is neither freshly distilled, filtered, nor sterilized, and, as a consequence, toxic effects are common Few users of arsphenamine or neoarsphenamine realize that the drugs are very unstable and that oxidation occurs rapidly, in the latter, according to Ehrlich,¹² 300 per cent in a half-hour

Probably few observers understand that distilled water is capable of dissolving red corpuscles, and with an easy water-soluble arsphenamine (as neoarsphenamine) solutions are often made which are capable of doing this in the blood stream after they are injected This is particularly pointed out by Ravaut¹³

For the sake of "safety first," it is demanded that all solutions be made with freshly distilled (not over five hours old) water, properly filtered and sterilized The solution should not be permitted to stand over five minutes before using and should always be hypertonic

Intravenous Technique for Arsphenamine—The instruments are one large 250 cc cylinder (Fig 129, B), filter papers, one funnel, one intravenous apparatus, like that shown in Fig 130, one graduated pipette (Fig 129, A), and one stock bottle of normal sodium hydroxide solution (4 per cent)

The instruments and filter paper having been previously sterilized (which may be accomplished for the latter by moist heat and later drying between sterile towels, and for the ampoule of arsphenamine and a file by immersion in alcohol), the ampoule is opened with the sterile file and the contents poured into the cylinder Fifteen cubic centimeters of hot water is added, and the salt is put into solution

rule found on other parts of the body. The *Spirochæta pallida* is easily demonstrated by means of the dark field condenser and the Wassermann reaction is always positive.

(c) **Gumma. Chancre Redux.**—Quite frequently there develops a so-called chancre redux which is nothing more than a recurrence at the site of the previous primary sore. It may appear any time from a few weeks after the healing of the primary sore to ten to twelve years afterward. Occurring after several years, it is regarded as a gumma by most observers.

Without any exact time of exposure or apparent period of incubation a small localized papule makes its appearance and rapidly breaks down and ulcerates forming a typical solitary cutaneous gumma. The diagnosis should not be difficult with a previous history of lues.

There is no question but that this form of lesion has been frequently reported as a "second case of lues in the same patient" but this was before the discovery of the *Spirochæta pallida* and the Wassermann reaction. It is possible always to find the spirochetes in a primary lesion and never possible to find them in a chancre redux with the dark-field condenser or any staining method. As the spirochetes are found deep in the tissues however their demonstration after the tissue method of Levaditi is possible. Treatment should be vigorous and systematic.

2 EROSIVE AND GANGRENOUS BALANITIS

FOURTH VENEREAL DISEASE.

Definition.—Erosive and gangrenous balanitis is a specific infectious disease with local and constitutional symptoms varying with the severity of the infection.

Etiology.—The cause is a symbiosis of a vibrio and a spirochete. These two organisms are always found together in the affection. Both have been demonstrated in sections in the blood vessels and in the inguinal nodes.

Predisposing Causes.—1. A long tight foreskin excluding the air to a greater or less degree.

2. Wetting the labia or penis with saliva.

3. Unnatural sexual relations after alcoholic excesses.

In private practice in this country the disease is uncommon probably occurring once in 200 cases but in dispensary work in which patients come from the lower walks of life the infection is fairly common. Scherber¹¹ reports 81 cases that were noted in Finger's clinic in four years.

In an article on ulcerative and gangrenous balanitis Reasoner¹² states that "in 708 hospital patients each of whom had some lesion that was suspicious of venereal disease, there were 49 who had acute infections with Vincent's spirochete, and of these 10 had a coincident initial syphilitic lesion. Infections caused by Vincent's spirochete are far more common in Europe than in the United States, but since the World War there has been an increase in this country.

to tell when the lumen of the vessel has been entered, as the blood will come pouring out. Then remove the constriction, turn the cock and send the solution into the vein. With the cylinder raised 28 to 30 inches above the patient's head, and with an 18- to 20-gauge needle, the solution will enter the vein in from seven to twelve minutes.

It is true that filtering the solution may seem to be superfluous, but often the salt agglutinates and there are small gelatinous particles that do not dissolve, and again, sometimes, there may be some splintering of glass in opening the ampoule. Therefore, in order to carry out this technique in the best possible manner, it is better to filter the solution so that it will be perfect.

When the solution has passed into the vein and the injection is at an end, the two-way cock is turned so that the blood returns through the side outlet. In this way it is possible to wash the puncture area with the patient's own blood, thus avoiding the use of salt solution.

Of late years neoarsphenamine, on account of its easy method of preparation and administration, has practically superseded arsphenamine. However, its efficiency as compared with that of arsphenamine, in the opinion of most American syphilologists, is less certain. It may be given in concentrated solutions with a 10- or 20-cc syringe.

The author's experience with many hundreds of cases, dating since the year 1910, has been devoid of accidents or deaths and the above technique for arsphenamine administration has been used exclusively.

Intramuscular Technique for Arsphenamine—All intramuscular injections of either arsphenamine or neoarsphenamine should be mentioned only to be condemned. It is true that the method prolongs the elimination of the drug, but it is attended by severe pain and induration, often followed by abscess and necrosis.

The time of the presence of the primary lesion is ideal for intravenous medication, as the spirochetes are not yet entrenched within the tissues.

According to the reports from five leading cooperating clinics in the United States¹⁴ continuous treatment, whether prolonged or brief, is superior to intermittent or other methods, and both are superior to so-called "intensive" treatment. There has been a steady increase in the intensity of arsphenamine therapy throughout the decade 1919-1928 with a slight drop in the intensity of heavy metal therapy about 1926, probably owing to the extended use of bismuth. Syphilis of the central nervous system is almost three times as common in those who receive little as in those who receive much arsphenamine. Comparisons between arsphenamine-mercury and arsphenamine-bismuth treatment disclose the latter to be the more effective as to ultimate results.

(b) **Ulcerated Papule.**—Occasionally during the period of secondary invasion numerous ulcerated papules are seen on the genitalia. This is more frequent in the areas in which there is less moisture in contradistinction to the condylomata, which occur on moist surfaces.

The diagnosis should not be difficult, as secondary lesions are, as a

etiological factors in gangrenous stomatitis and gingivitis erosive and gangrenous balanitis must be due to the same cause since the organisms are found in such abundance in these conditions and especially since in the histories of all my cases unnatural sexual relations or a wetting of the labia were admitted

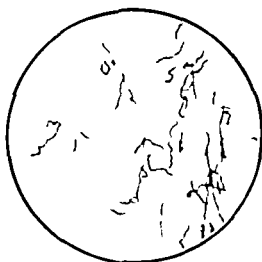


FIG. 131—*Vibrio* and spirillum culture from case of gonorrhea. Slide and culture by Dr. Ruth Tunnickoff

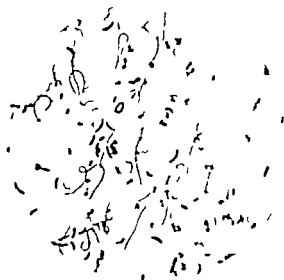


FIG. 132—Etiological factors in erosive and gangrenous balanitis. (Author's case)

The vibrio grows under anaerobic conditions on serum agar. It occurs single or in chains of two or more individuals. It is a slightly curved rod-shaped organism with pointed ends measuring about 2 microns in length and 0.8 micron in width. It stains by the ordinary dyes and is Gram-positive, although the decolorization must be performed very carefully as the organism gives up the gentian violet readily. It is preferable to use 70 per cent alcohol for this purpose.

"Erosive and gangrenous balanitis is not of necessity venereal in origin although it usually is so. In the presence of a chronic infection of the mouth and in the absence of a definite history, the infection should not necessarily be considered to be venereal. The gangrenous type of balanitis is rare. Except in a case of an emergency, it is not good practice to use arsphenamine in the treatment of a genital infection until its syphilitic nature has been definitely determined. The exclusion of syphilis may be more difficult and is more important than the diagnosis of erosive and gangrenous balanitis."

Bacteriology—At the Department of Pathology and Bacteriology of the University of Illinois¹⁷ an investigation was conducted to ascertain whether spirochetes and fusiform bacilli occur in the *normal* sexual organs (as has been reported by various authors) and if so, to what extent. Of the 100 patients examined 35 were between twenty and thirty years of age and 65 were between thirty and forty years of age. It was found that 51 per cent harbored spirochetes together with fusiform bacilli. In all the specimens staphylococci, often diphtheroids, Gram-negative bacilli and occasionally streptococci were found. From smears, cultures and animal experiments, it appeared that there is a striking similarity between the flora of normal preputial secretions and that of erosive and gangrenous balanitis. Hence the findings of other writers were confirmed.

Abundant evidence is at hand to show that in noma and in Vincent's angina the etiological factors are a spirochete and a vibrio. Róna¹⁸ says that "noma begins without exception in gangrenous stomatitis. If the fusiform bacillus and spirochete found in the mouth are etiological factors in gangrenous stomatitis, since the organism is found in such abundance in noma, it must be due to the same cause."

In the first publication of the writer on this subject¹⁹ numerous authors were cited and abundant clinical proof was obtained to substantiate the pathogenicity of these organisms.

The author has repeatedly examined the spirochetes found in Vincent's angina under the dark-field illuminator. Here the organism is identical with that found in erosive and gangrenous balanitis, the motility being one of the characteristic and diagnostic features.

Since the conditions that favor the growth of these organisms—heat, moisture, filth, and absence of air—are more ideal in the genitalia than in the mouth, it is easy to conceive how an organism may leave its normal saprophytic domain and under proper anaerobic conditions become pathogenic and produce extensive destruction.

Examinations of vaginal secretions of 100 normal women showed bacteria and spirochetes similar to those found in smegma, but no spirochetes of balanitis.

In 11 cases of clinically evident vulvitis and vaginitis, vibrios and spirochetes were found.

As shown in Fig. 132, the vibrio and spirochete are the predominant organisms found. We can easily argue, as did Róna in 1905, that if the fusiform bacillus and the spirochete found in the mouth are

In the more severe grades of infection there is more venous stasis and more exudation resulting in marked phimosis which predisposes to gangrene. As Scherber and Müller pointed out the whole condition is one of degree only but for clinical purposes we may distinguish two types (1) balanitis erosiva circinata and (2) balanitis gangrenosa.

Symptoms.—*Balanitis erosiva circinata* commences with the appearance of one or more small grayish white patches in the preputial sac. At the time of the development of the erosion a thin pus is produced with a characteristic stinking odor and of the usual yellowish white in the more severe cases it becomes grayish white or grayish brown.

Pus from the lesions is innocuous. In its development the inoculation never becomes pustular but necrosis of the epithelium always represents the beginning, and the future process is polycyclic.

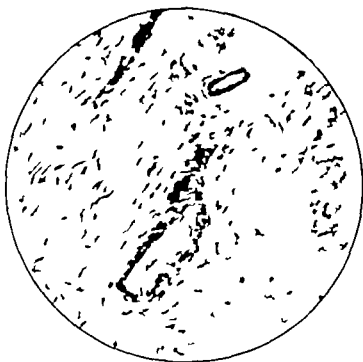


FIG. 134.—Erosive and gangrenous balanitis (high power). Shows a blood-vessel with moderate amount of leukocytes in the adventitia. There is no proliferation of the endothelial lining or occlusion of the lumen. (Author's case.)

Infection shows a preference for the sulcus coronarius next on the inside of the prepuce and last on the glans. Later all of the glans penis is involved and under favorable anaerobic conditions the whole fossa navicularis is affected. It must be borne in mind that more or less phimosis is an essential factor.

In the mild cases the foreskin may be easily retracted but in the more severe forms marked phimosis develops there is considerable itching and burning behind the glans the act of urination is practically without pain. In contradistinction to the gangrenous form in this type of the disease constitutional symptoms are slight or absent.

As the process follows no hard-and-fast lines, there are certain devia-

The spirochete is Gram-negative, but stains with the ordinary dyes, with the Giemsa stain it takes a bluish red. These organisms are best seen with the dark-ground illuminator. They average from 6 to 30 microns in length and about 0.2 micron in width. The windings are not acute and the ends of the organism terminate in the center of the spiral. The motion of the organisms is very rapid, they travel from place to place, resembling small snakes, they have a rotary motion, but this is not so pronounced as the backward and forward motion.

After unsuccessful attempts at animal inoculation with cultures, Scherber does not believe in the pathogenicity of the fusiform bacillus and considers the spirochete responsible for the lesions.



FIG. 133 —Erosive and gangrenous balanitis (low power). Shows the epithelium flaked off at the site of a small superficial erosion. There is an exudation of leukocytes but in contradistinction to chancreoid and chancre this is not marked. The vascular tissue is not increased. (Author's case.)

A rapid and simple method of collecting the pus is by capillary attraction with small capillary pipettes. These may be pushed deep into the ulcers and a quantity of fresh discharge obtained. The pus may be examined with the dark-field illuminator, or fixed and dried and stained from two to three minutes with carbol-fuchsin. It is to be examined without cover-glass with oil immersion.

Pathology —The pathological condition in the milder forms of balanitis erosiva circinata consists simply of a flaking off of the epithelium, leaving small superficial erosions. When the desquamation is more marked there are bright red ulcers, which are surrounded by a small white zone, the remains of the necrotic epithelium (Figs 133 and 134).

In the surrounding tissue there is an exudation of leukocytes and plasma cells. The organisms are found in the necrotic membrane. At times they can be demonstrated in the tissues and blood-vessels, as shown by Scherber and Muller.²⁰

inner surface of the foreskin it shows externally as a dark bluish-red area within the surrounding bright red inflammatory tissue. The congestion and abnormal pressure due to edema favor the progress of the disease.

Soon the foreskin over the ulcer becomes black and a complete necrosis of the part occurs. If the ulcer is situated on the glans in a short time it may produce complete destruction of the glans or may even cause an extremely rapid gangrene of the organ which may extend even to the root of the penis as may be seen by the author's fourth case, herein described.

The ulcers in these cases are deep the edges are sharp and perpendicular the base is grayish green or brownish or the penis may show hemorrhagic areas or be changed into a black necrotic mass.

The discharge at this time is more offensive than in the erosive type it is grayish yellow or yellowish brown and at times it may be slightly hemorrhagic but always with the same characteristic odor. The inguinal nodes are enlarged there is a mild grade of syphilis present and general malaise is marked. There may be vomiting and the temperature may reach 101°F . The tenderness of the part is extreme.

Diagnosis—This disease is not so uncommon as one might suspect. Unfortunately it is usually mistaken for chancreoid infection. The period of incubation may be the same in the two conditions but with the characteristic thin yellowish white offensive discharge in which one finds a vibrioform organism and a spirochete the diagnosis should not be difficult.

The ulcers of the two forms of infection may simulate each other very closely. In this form of balanitis when the infection is at all severe there is marked phimosis and considerably more inflammatory reaction. The enlarged inguinal lymph nodes are painless while with a very insignificant chancreoid sore a suppurating bulbo is often present.

Chancreoid ulcers are as a rule multiple but they do not spread with great rapidity as do those of the ulcerative form of balanitis. Whereas the borders of the ulcers in both diseases have a clean-cut punch-out appearance there is greater tendency to undermine the wall in a chancreoid infection.

On account of the indolent adenopathy that accompanies balanitis erosiva it must be differentiated from syphilis. In syphilis the period of incubation is longer although the two infections may occur simultaneously as reported in one of Scherber's cases as well as in one of my own. When such a condition exists we may be compelled to defer our diagnosis of syphilis until the period of incubation for syphilis has elapsed or in case of a mixed lesion the *Spirochaeta pallida* may easily be demonstrated by the dark-ground illuminator and is so characteristic as to be easily differentiated from the spirochete of balanitis.

Herpes preputialis always occurs as groups of small insignificant vesicles in which local reaction is mild or entirely absent. This condition simulates the mild form of balanitis erosiva somewhat but in herpes one fails to find the organisms characteristic of balanitis.

tions from the foregoing picture. The process may be limited to the glans, and the inner surface of the foreskin may be unaffected. This may be extreme or mild, but it is always present on the covered portion of the glans.

The inflammatory condition may remain a purely erosive, superficial process and may recover spontaneously. Berdal²¹ says that in simple cases healing takes place in four or five days. Scherber has seen spontaneous healing almost completed in forty-eight hours by simple washing and admission of air by retracting the foreskin. He further states from observation that the height of the development usually occurs in from four to eight days after exposure to infection, and that he has seldom seen cases of four weeks' incubation and cases persisting for three or four weeks. Frequently the process does not remain superficial, but deep diphtheritic and gangrenous ulcers develop which complicate the clinical picture in many ways. In some cases, when the foreskin can be retracted, after removal of the pus, small, round ulcers can be seen inside of the erosions, varying in size from that of a pin-head to that of a pea. These ulcers are moderately deep and, on the whole, flat and surrounded by a red zone. They are covered by a closely adherent pseudomembrane. In other cases the ulcers are more extensive and deeper, the average size being about that of a dime. These may become confluent and extend over the whole surface of the sulcus or the inner surface of the foreskin.

These balanitic ulcers are of a somewhat irregular outline and are surrounded by small inflammatory, slightly elevated borders. These borders are clean cut and the sides somewhat slanting, the bases are uneven, with a firm yellowish-white or yellowish-brown membrane, which is often edematous and swollen. When more edematous, this false membrane appears as a sort of friable slime. Here and there may be hemorrhagic spots which sometimes give rise to hemorrhages from the base of the ulcer.

In the severe forms the constitutional symptoms are more marked. Scherber and Müller noticed chills and fever in a majority of their patients, and at the onset, vomiting. The average temperature ranges from 100° to 101° F. There is marked edema, the external skin being red and edematous, the infiltration may extend to the root of the penis in some cases. The dorsal lymph cord is usually palpable and the inguinal nodes are enlarged, but not painful. Unless the phimosis is complete there is no pain on urination, when, however, the urine does not pass freely and dilates the preputial sac, there is considerable pain.

The discharge is the most profuse in this type of the disease. By gently irrigating the preputial sac with sterile water and wiping the external urethral orifice, one can easily exclude gonorrhea by using the two-glass urine test.

In the majority of cases of balanitis gangrenosa, there occurs a marked edema of the subcutaneous tissue of the penis which extends to the root and causes a marked phimosis. If the ulcer is situated on the

Examination—The general muscular development was good there were no scars or evidence of previous venereal disease. The penis was swollen and edematous the edema extended about half way up the shaft of the penis giving it a pear shape. The skin over the glans portion was red and slightly injected. There was complete phimosis. Exuding from the opening was a thin yellowish white pus with a penetrating odor in the pus a vibrio and a spirochete were found. There was constant burning pain which was increased on the slightest pressure. There was no urinary pain. The dorsal lymph cord was easily palpable the inguinal nodes were enlarged but not tender. There was no fever.



FIG. 130.—Erosive type complicated by syphilitic infection. Case II. Foreskin retracted grayish purulent secretion in sulcus coronarius and a few small erosions on the glans. (Author's case.)

Treatment—With a small hard syringe 2 per cent hydrogen peroxide was injected every hour into the preputial sac. By the second day the foreskin could be retracted showing numerous small ulcers with sloughing bases and sharp borders, involving the sulcus and the covered portion of the glans. These healed rapidly under treatment.

CASE II—Erosive type complicated by syphilitic infection

History—C. F. aged nineteen years, single. No previous venereal disease gave a history of many exposures. Last exposure four days previous unnatural relations. After six days of incubation the patient presented himself at my clinic at the Post Graduate Hospital.

Treatment —As a prophylactic measure, the practice of circumcision should be encouraged, it is absolutely impossible for balanitis to exist in a person who has been circumcised

In many cases in which the condition is mild and the foreskin can easily be retracted, all that is necessary is a thorough cleansing, but in the mild ulcerative forms in which there is the slightest evidence of phimosis, a dorsal incision should be made. As the organism of balanitis is anaerobic, this incision serves the twofold purpose of admitting air and of exposing the diseased parts for treatment.

The natural tendency in this disease is to burn all the sloughing ulcers, but such treatment subjects the patient to needless punishment. As said before, the organisms of the disease are anaerobic, and as hydrogen peroxide liberates oxygen when in contact with organic matter, it acts as a specific for this form of infection.

The ordinary 2 per cent solution is sufficient, but in severe cases of gangrenous balanitis stronger solutions of peroxide may be procured and painted on the parts.



FIG 135 —Erosive type, Case I. Balanitis erosiva, foreskin not retracted, ulcers seen on margin (Author's case)

REPORT OF CASES

CASE I —Erosive type (Fig 135), previously reported

History —M M W, aged forty years, married, denied all previous venereal history. After four days' incubation the patient noticed itching and burning around the glans penis. There were no constitutional symptoms. During the first week this continued as a mild balanitis. The patient was able to retract the foreskin. Treatment was neglected. At the end of the first week conditions suddenly became worse, the foreskin began to swell and the patient was unable to retract it. At this time he presented himself for examination.

four hours before presenting himself for examination it suddenly began to swell and was extremely painful on examination. Profuse stinking discharge. Dorsal lymph cord was palpable. Slight painless inguinal adenopathy was present.

Operation—Dorsal and ventral incisions were made showing both superficial and necrotic ulcers present at the borders of the glans and the sulcus coronarius as seen in Fig 137. Numerous vibrios and spirochetes were obtained from the necrotic ulcers.

Treatment—Two per cent hydrogen peroxide thorough cleaning with hand syringe every two hours, prompt recovery. Unable to obtain second photograph. There is no doubt that this case would have gone on to gangrene had not prompt treatment been instituted.

CASE IV—Erosive type.

History—P. O. S. aged twenty-six years. History of previous gonorrhea. Unnatural relations were held thirty-six hours previously.

Examination—Typical pear-shaped swelling of the penis. The foreskin was retracted. Whole of glans penis and sulcus coronarius covered with superficial ulcers. Average size about the head of a pin. Profuse purulent discharge containing vibrios and spirochetes. Dorsal lymph cord palpable. No adenopathy.

This patient was so slovenly and careless that after two days of marked improvement he discontinued treatment and had a recurrence, with a later cure.

CASE V—Erosive type, previously reported.

History—M. W. M., aged twenty-six years. Denied syphilis, had had a supposed chancroidal infection two years previously. Two weeks before presenting himself the patient had intercourse. After three or four days there was a little itching beneath the prepuce. At the end of six days he presented himself for examination.

Examination—The temperature and pulse were normal. The general nutrition was good and there were no signs of latent syphilis. There was a large indurated swelling of the penis. From the preputial orifice exuded a thin yellowish white stinking discharge. This was examined for gonococci, but none was found. There was phimosis but it was not complete. With dilatation the finger was gently passed between the foreskin and the glans. The whole covered portion of the glans and the inner leaf of the foreskin were covered with small ulcers, having necrotic sloughing bases. Those on the inner leaf extended to the border of the preputial fold. By gently pulling back the foreskin the whole could be plainly seen. The dorsal lymph cord could be easily felt and the inguinal nodes were enlarged but not tender. There were no constitutional symptoms.

Treatment—The patient was given a wash of hydrogen peroxide full strength (2 per cent). As he did not return to the clinic it is presumed that his condition was satisfactory.

CASE VI—Gangrenous type, previously reported.

History—A. G. G. aged forty-three years. Denied all previous venereal history. He had had intercourse nine days previously. At

Examination — Well-developed individual, general examination negative Pulse and temperature normal No enlargement of the lymph nodes, profuse yellow discharge from the preputial opening Moderate amount of phimosis present Foreskin was retracted with little difficulty, showing numerous typical superficial erosive ulcers, both in the sulcus coronarius and on the glans penis Complicating this, however, was a hard, indurated, erosive chancre seen just back of the corona on the left side The sulcus was filled with purulent discharge, as seen in Fig 136

By examination with the dark-field illuminator it was possible to make a differential diagnosis at once, for there were present the *Spirochæta pallida*, the spirochete of erosive and gangrenous balanitis



FIG 137 —Erosive type, more advanced stage, Case III Foreskin retracted after dorsal incision, deep erosive ulcers with necrotic bases just back of the sulcus coronarius (Author's case)

and numerous vibrios No other method could have given such prompt diagnosis

Treatment —Two per cent hydrogen peroxide and salvarsan resulted in a prompt resolution of the erosive condition

CASE III —Erosive type, more advanced stage

History —F P E, aged twenty-one years, single, private patient No history of any previous venereal disease, incubation six weeks (patient's statement), at which time unnatural relations were had with the idea of avoiding exposure by the ordinary channels.

Examination —Large, corpulent man, general examination was negative pulse and temperature were normal Considerable phimosis present, penis slightly swollen Extreme tenderness on examination Foreskin was not retractable, patient stated that during the month previous there was a little itching behind the glans, but that twenty-

TABLE I

DIFFERENTIAL DIAGNOSIS BETWEEN SYPHILITIC CHANCER, CHANCROID, HERPES, AND
EROSIVE AND GANGRENOUS BALANITIS.

	Syphilitic chancre	Chancroid	Herpes	Erosive and gangrenous balanitis
Etiology	<i>Spirochaeta pallida</i>	Ductey Unna bacillus	No organisms	<i>Symbioblasts</i> , vibrio and pirochete
Incubation	Fourteen to twenty-one days	Two to five days	None	Three to five days may be longer
Location	Generally on genitals may be anywhere	Generally on genitals rarely elsewhere	Generally on genitals may be anywhere	Always on glans penis behind closed foreskin may extend to adjacent parts.
Number	Usually single, but may be double must be so from onset	Usually multiple; may develop additional ulcers at any time during activity of infection	Usually multiple later confluent	Usually multiple.
Auto-inoculable	Possible up to ten days	Possible at any time	No	Only possible under anaerobic conditions.
Onset	Starts as erosion or papule	Pustule or ulcer	Group of vesicles	Small superficial erosion.
Course	Remains as erosion or ulcerates.	Ulcer extends	Forms superficial ulcer	Becomes confluent rapid coalescence
Induration	Usually present	Rare	None	Slight
Pain	Little or none	Very painful	Burning and itching	Very painful
Shape	Round or oval symmetrically, irregular	Round or oval unsymmetrically irregular	Irregularly rounded, border polycyclic	Irregular round or oval border polycyclic.
Depth	Superficial, cup-shaped or saucer-shaped may be elevated	Deep, excavated or punched out	Superficial	Superficial at first may extend deep.
Surface	Smooth and shining darkish-red membrane frequent	Rough, moth-eaten grayish warty appearance	Bright red superficial granulation	Rough necrotic centre slightly reddened border may be yellowish-brown membrane.
Edges	Sloping, but may be elevated	Clean cut, may be undermined	Sharp not undermined	Clean cut; not undermined somewhat slanting sides.
Bottom	Smooth and shining	Uneven and irregular no luster	Bottom even; diffuse inflammatory tissue	Gray and irregular no luster
Secretion	Slight unless irritated, then profuse serous	Abundant and purulent	Slight, seropurulent	Profuse, stinking, gray to grayish brown discharge.
Adenitis	Constant indolent	When present, always inflammatory	None	Constant, indolent.
Gangrene	Rare, unless complicated by erosive and gangrenous balanitis	Rare, unless complicated by erosive and gangrenous balanitis	Never	Often.

that time the patient said that the prostitute lubricated the labia with saliva. The following day the glans portion began to swell, there were chilly sensations, no nausea or vomiting. Previous to this time the glans penis was exposed between the preputial fold, and the foreskin could be retracted. On account of the rapid phimosis that developed this could not be accomplished later. The local symptoms increased rapidly, by the third day gangrene had set in.

Examination — When the patient presented himself at the clinic he was well nourished, muscular development was good. There was a slight septic intoxication. The entire preputial covering for a distance of 3 inches was a black, necrotic mass (Fig 138). By gentle manipulation the necrotic mass could be drawn away and deep sloughing ulcers, with sharp borders, could be seen extending into the penis above the glans. There was considerable thin, slimy pus present, with an odor of



FIG 138 —Gangrenous type, Case VI. Appearance on examination. (Author's case)

necrotic tissue. Here we were able to find the organism in large numbers. The remaining portion of the penis was dark red and infiltrated, the edema extending to the root, the inguinal lymph nodes were enlarged. The patient's temperature was 102°F , malaise was marked.

Treatment — The patient was sent to the County Hospital. The necrotic foreskin was cut away, and just above the glans portion, at the site of the inner preputial fold, two deep ulcers could be seen. The glans portion was necrotic. In forty-eight hours (Fig 139) the entire glans, together with about $1\frac{1}{2}$ inches of the shaft of the penis, sloughed off, leaving a short stump (Fig 140). The patient was treated with irrigations of potassium permanganate three times a day, but the organism had already invaded the deeper layers, and gangrene was unavoidable.

While this disease is still very common among dispensary patients, one only occasionally sees a case in private practice nowadays.

1 CHANCROID

THIRD VENEREAL DISEASE.

Synonyms.—Simple ulcer simple venereal ulcer soft chancre or *ulcus molle*.

Definition.—A specific infectious ulcer usually acquired during the sexual act almost always situated upon the genitals, but may be found on any part of the body.

Etiology — A. *Predisposing Causes* — (1) Race—most frequent among colored people. (2) Phimosis causing retained secretions. (3) Poor and ill-nourished persons do not resist the infection well. (4) Filth and poverty and debauchery and degeneration go hand in hand with this infection as a consequence it is more frequently seen in dispensary practice than in private work. During the author's five years experience at the Post-Graduate Hospital situated in the center of Chicago's red-light district he was particularly struck by the frequent occurrence of this infection in the colored race.

The Surgeon-General's report for the year 1931 shows the incidence of chancreoid per 1000 in the U. S. Army as 7.5 in the Navy as 3.02. Chancreoid is far more prevalent than syphilis in the Navy. De Keyser² gives the incidence of chancreoid in the United States as 6.7 per thousand in 1924-1925.

B. *Exciting Cause* — *Ducrey-Unna bacillus*.

Description — It is a short rod-shaped bacillus with slightly rounded extremities, occurs often in chains sometimes in groups either in cells or between them and is readily stained with methylene blue carbol fuchsin or borax-methyl violet. It is decolorized by Gram's method. On account of the contamination by extraneous organisms the demonstration of the *Ducrey-Unna bacillus* is difficult.

Pathology — Microscopically there is found at the bottom of the epithelial erosion an infiltration of leukocytes which extends laterally only a little beyond the hyperemia. The exciting causes of the ulcer the delicate and difficult to stain little rods (*Ducrey-Unna bacillus*) line the tissue. These bacilli make their way out from the hyperemic area along the course of the lymph spaces into the lymphatic channels as these lie open with unobstructed lumen the rapid march of the infection to the neighboring glands is the rule (Figs. 141 and 142).

As a consequence of secondary infection with other bacteria which gain entrance through the local ulcer an extended necrotic disintegration can reach into the surrounding tissue. This may extend both laterally and deeply and lead to wide destruction of tissue. Such a condition is known as phagedena. Occasionally the lymphatics that drain a given ulcer appear as red streaks or lines passing backward to the regional lymphatic glands. These are easily palpable and may be quite painful.

Symptoms.—Incubation ranges from twenty-four hours to three days occasionally five to nine days are given by the patient at this time however the ulcer is well advanced.



FIG 139 —Gangrenous type, Case VI Appearance forty-eight hours later
(Author's case)



FIG 140 —Gangrenous type, Case VI Appearance five months after, showing small
stump left (Author's case)

After sexual indulgence with varying periods of incubation a small congested spot makes its appearance this rapidly forms a small macule which later develops into a pustule surrounded by a hyperemic zone. This usually increases rapidly in size the superficial layer of the cutis is either pulled off or falls off revealing an ulcer the exact size of the superficial crust.

These ulcers are deep and have a characteristic punched-out appearance. The edges are steep and are frequently undermined. The floor has a dirty gray moth-eaten appearance and until this dirty gray sloughing base is replaced by granulation tissue healing will never occur. The discharge is purulent and profuse and may be bloody at times. Constitutional symptoms are absent and remain so unless there is lymphangitis or inguinal adenitis.

Pain—In contradistinction to the specific lesion of syphilis chancreal ulcers are extremely painful and are capable of autoinoculation often spreading to a great extent. A single ulcer is seldom seen multiplicity is the rule.

Location—The ulcers are generally confined to parts where the greatest friction during coition takes place. In the female the labia or vestibule is most frequently involved occasionally the external urethral orifice is the site of infection. In the male abrasion or tears take place most frequently in the sulcus coronarius around the frenulum at the edge of the prepuce and the external urethral orifice. These places are the sites of predilection. When the ulcer is situated at or within the external urethral orifice urination is always painful. Occasionally a gland follicle becomes the site of infection here the ulcers may burrow deep and undermine the surrounding tissue and the gland opening may be the smallest part involved.

Mixed Sore—It is indeed common to find both chancreal and chancre in the same patient either in the same ulcer or in different ulcers. Often an inflammatory hardness is present in chancreal that simulates the induration of the specific chancre.

Diagnosis.—There is no single condition that receives such careless attention as do simple ulcers that occur on the genitals. Few observers realize the importance of an exact diagnosis especially if the infection is syphilitic. Unfortunately the Ducrey Unna bacillus is difficult to find and is little known in this country. Fortunately however a diagnosis can be reached by exclusion which is just as accurate and more rapid than finding the exciting cause of chancreal itself. Every genital ulcer should be examined carefully for the *Spirocheta pallida* and search continued diligently until the presence of the organism is excluded before any mutilation or treatment is practiced in the way of cauterization dusting powders etc. There is no longer any excuse for haphazard diagnosis in cases of genital ulcers. It is true that clinical appearances multiplicity lack of induration etc. may be clear and characteristic but no one should permit an ulcer to come under his care without a thorough microscopic examination.

In most American text-books frequent reference is made to gan-



FIG 141 —Chancreoid (low power) Shows infiltration of stroma with lymphoid cells and polymorphonuclear leukocytes No increased vascularization No infiltration of blood-vessel walls (Author's case)

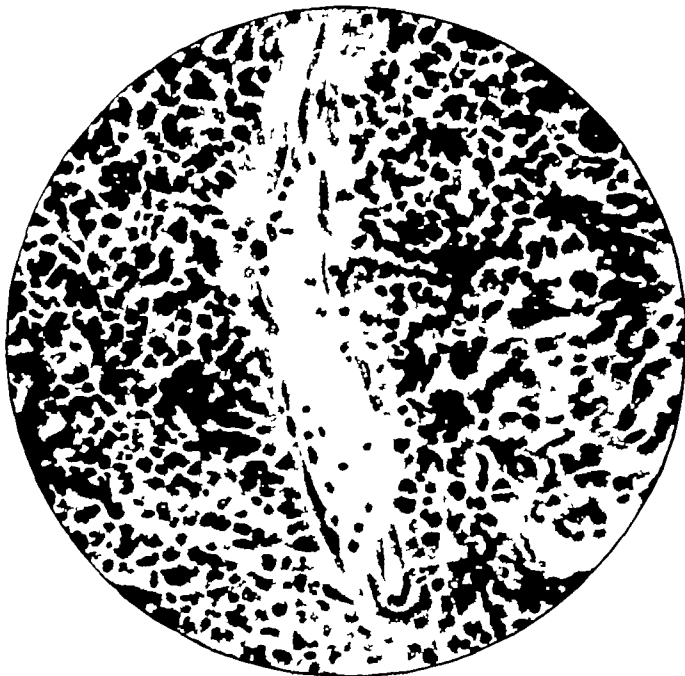


FIG 142 —Chancreoid (high power) Shows blood-vessels with polymorphonuclear leukocytes in lumen, but no thickening of walls

be destroyed by eucaine gr 15 to 35 or by placing in the bottom of a stocking or tobacco pouch ground coffee over which a layer of cotton is placed. The affected part is then dusted with iodoform and tied into the sack.

A favorite and efficient ointment that may be applied is the following

Iodoform	5
Balsam of Peru	50
Petrolatum	500

The use of dusting powders is pernicious and is to be condemned as most of them have no real antiseptic properties and only tend to crust over the lesion and hasten absorption with resulting adenitis.

Morton recommends the chloride of zinc pulp which is prepared by adding a few drops of water to chloride of zinc.

A favorite method in some hospitals is the continued application of phenol neutralizing each application well with alcohol.

Robbins and Seabury²² first apply a 2 per cent solution of copper sulphate in distilled water to the sore next the short high-frequency spark from a rather fine-pointed vacuum electrode is applied directly to the lesion for from one to three minutes depending on the extent of the ulceration. Especial care is exercised in carrying the point of the electrode well down into any fissure or undermined edge and the area of application should extend over the edge of the sore about $\frac{1}{8}$ inch into the doubtfully healthy area.

The current is not turned off until every crack and crevice has been thoroughly treated and the surface of the sore is changed to a dark greenish gray. If the sore is exposed it should be covered with a thin moist dressing for which any very dilute antiseptic solution may be used as a 1 to 10 000 or 1 to 20 000 mercuric chloride solution or even tap-water answers nicely in most cases. This should be changed once or twice daily and must not be allowed to stick.

The patient is instructed to return in two days and if the work has been carefully done the wound will present a perfectly healthy granulation that will go on to complete healing in a few days. If the sore does not look clean the application is repeated at the second visit.

Chancroid situated at the urethral orifice should not be cauterized if it is at all possible to cause its healing without so doing.

Vaccine Therapy — Nicolle and Durand²³ in 1924 succeeded in making a specific vaccine with which they demonstrated the specific response of the body to the infection and which they also used in the treatment of chaneroid with complete success. Some writers believe that the vaccine therapy is indicated in all cases of bubo phagedena and inaccessible chancroids. The injection of 225 000 000 bacilli is sufficient to check the progress of the condition. Pardo-Castello reports that he has used Nicolle's vaccine since 1927 with uniformly good results.

Complications. — 1 *Phimosis* — This condition is a common and often troublesome complication of chancroid the condition *per se* is not so

genuous conditions that often accompany chancroid. This condition, described in detail in the latter part of this chapter, is caused by a symbiosis of specific organisms. Here careful microscopic examination with the clinical history will permit of an exact diagnosis. For further discussion on the diagnosis of chancroid see Chapter on Syphilis.

Herpes, occurring on the genitals, is often mistaken for chancroid infection, unless seen during the vesicular stage, these erosions are superficial, have little discharge and are not painful. Lymphangitis and adenitis are lacking, microscopic examination is negative.

While the Wassermann reaction, the technique of which can be found in any modern text-book on clinical diagnosis, is absolutely valueless as far as an early diagnosis is concerned, occasionally an ulcerated papule or chancre *reductus* (see description) may simulate chancroid infection. Here the application of the test should be a valuable aid in diagnosis, however, the fact should not be lost sight of that the consumption of large quantities of alcohol just before the test is made may cause a negative reaction and the test may be worthless.

Intradermal Diagnostic Test—Pardo-Castello²³ says that Nicolas, Lacassagne and Alcalay reported on the general systemic reaction following an intradermal test. They found it positive in 100 per cent of their patients who had had chancroid at some time. *Dmelcos* is merely the proprietary name of the *vaccine* prepared by Nicolle from the Ducrey bacillus, *i. e.*, the bacillus of chancroid. When a positive reaction is obtained after the intradermal injection of *dmelcos*, chancroid may be positively diagnosed.

Treatment—*Prophylaxis*—The wearing of a condom during the sexual act is the most reliable preventive. Thorough cleansing with soap and bichloride (1 to 5000) may be employed, however, the latter will not always prevent infection.

It should be borne in mind that no treatment of any kind should be instituted until an accurate diagnosis is made, then treatment should be prompt and efficient.

As the exciting organism lies deep in the tissues, cauterization has been the favorite method of attack for years, and it is rather strange that so many different caustics and methods of application should be recommended. Taylor, as cited by Watson and Cunningham,²⁴ recommends the application of liquefied phenol, followed immediately by the application of nitric acid. Care should be taken to use considerable pressure and to undermine the edges, without touching any of the healthy skin with the caustic. This is a favorite method of the author.

By applying the phenol first, considerable local anesthesia is produced, so that the subsequent burning with nitric acid is not so painful. Under no consideration should phenol or silver nitrate be used alone, as only the superficial portion of the lesion is scarified, underneath which infection is sealed up and a resulting adenitis is rapidly manifested.

Iodoform as a dusting powder is superior to all others, its odor may

saries, for among them heavy lifting and walking predispose to the infection. Among the better class of patients, inguinal adenitis is rather infrequent.

2. Exciting Cause—The exciting cause is the Ducrey-Linna bacillus. The chancreoid form of infection invariably causes an inguinal adenitis unless the primary infection is attended to promptly.

Symptoms.—The adenitis generally occurs in the second or third week of the chancreoid infection unless the ulcers have been carelessly cauterized in which case it occurs earlier. If the ulcer is on the right side the right inguinal glands become involved; if on the left side the left side is involved; however when the ulcer is on the frenulum or on both sides either or both sides may be involved.

Pain is the first symptom that attracts the patient's attention and this is increased with walking or the slightest exertion.

On palpation the individual inguinal glands that run parallel to Poupart's ligament are easily identified. The glands are hard and very tender while the skin over the mass is slightly congested and freely movable. At this period either the glands may undergo resolution and recede or the condition may become progressively worse. Considerable periadenitis occurs; the glands become matted together in irregular tender masses and adherent to the skin and the subjacent tissue; the former becomes boggy, dusky red and edematous, and softening occurs rapidly in some cases with spontaneous rupture. Frequently the exact counterpart of the chancreoid is depicted in an inguinal adenitis. The base of the suppurating glands is dirty gray and there is extropion of the walls with undermined edges (virulent bubo).

On cross-section such a gland shows numerous military abscesses. Some of course undergo resolution but many break down, become confluent and leave the whole gland as an abscess cavity, with the gland capsule alone as the limiting membrane. Occasionally the extension of a phagedena into the inguinal adenitis is seen forming a serpiginous ulceration.

Treatment.—*Prophylactic*—The prompt and early surgical treatment of all chancreoid ulcers (see Treatment under Chancreoid) should be resorted to. Never cauterize the chancreoids with silver nitrate or phenol alone as these tend to seal over the top of the ulcer and cause absorption from the under strata which invariably produces an adenitis in twenty-four hours.

Palliative—The sore having been previously cleansed and cauterized the parts are shaved and scrubbed; hot bichloride (1 to 5 000) or boric acid dressings are applied; the patient is bandaged firmly with a spica bandage and put to bed.

This hot dressing is changed every two or three hours. This procedure with rest in bed will cause resolution in the glands that are not too far involved and will hasten softening in those that are far advanced. Continuous wet alcohol dressings in the same manner that the wet bichloride dressings are applied may help to cause resolu-

serious as the delay in the diagnosis of the ulcer that is causing the condition. Often it is possible to retract the skin enough to obtain material for diagnosis. However, when this cannot be accomplished, prompt incision and exposure of the ulcer is recommended. It is true that the line of incision may become infected if chancroid is present, but the patient, on the other hand, may be saved from the period of secondary syphilitic invasion, and this is worth while.

It is possible in some cases to cause a resolution of the condition by immersing the glans in hot water and irrigating with hydrogen peroxide.

Ten per cent iodoform in glycerin is recommended as efficient. However, all palliative treatment should be discouraged until a positive diagnosis has been made.

2 *Paraphimosis* — Occasionally this condition is seen associated with genital ulcers. Contrary to the condition of phimosis, there is no obscuring of the etiological factor, and after a diagnosis has been made, either incision of the constricting band or manual reduction can be resorted to.

3 *Phagedena* — Before the days of antiseptic surgery, phagedena was a very formidable complication of chancroid. Its etiology was little understood. We have come to know that the Ducrey-Unna bacillus is always present, associated, as a rule, with the streptococcus, although almost any pyogenic organism may be found at times. Numerous text-books still confuse phagedena with gangrenous conditions that occur around the glans penis. It must be distinctly understood that this form of gangrene has a distinct and separate bacteriology (see Erosive and Gangrenous Balanitis), and should no longer be mistaken for phagedena.

Treatment — As this condition is almost always associated with debility and malnutrition, tonics and supportive treatment should be instituted. Locally, the ulcers must be cauterized, so that nothing but healthy tissue remains. At times it may be necessary to use the actual cautery. A continuous hot-water bath, either by means of the sitz-bath or immersion of the organ in a vessel of hot water, greatly facilitates resolution and repair.

Sequelæ — (1) Lymphangitis, (2) lymphadenitis.

Lymphangitis always accompanies chancroid infection in a greater or less degree, and in the milder form needs no treatment. However, in debilitated persons sometimes this is very severe and distressing. Continued hot soaking or hot, moist applications should be employed, and if softening and fluctuation become manifest, incision should be promptly made.

INGUINAL ADENITIS OR INGUINAL BUBO

This is a frequent and severe complication following chancroidal infection.

Etiology — 1 *Predisposing Cause* — The condition occurs frequently among the poor, laboring classes of patients who attend the free dispen-

admitted during that time. The predisposition of the negro to the infection has been demonstrated throughout the United States. Lewis²¹ also states that the disease is very common among the colored race. He has seen no case in a female of the white race. However, among males of the white race it is not so rare as has been thought. During his practice the author has seen 1 case in a white male.

The organism originally described by Donovan²² is found in smears made from the granular tissue exudate and is considered pathognomonic.

The present method of treatment most in vogue was described by Aragao and Vianna in 1912. They pointed out the almost specific action of antimony and potassium tartrate (tartar emetic) when given in intravenous solution. Since that time Hoffman²³ Reed and Wolf²⁴ Campbell²⁵ Cummings²⁶ Cuthbert²⁷ and others in addition to those already cited have made valuable contributions on the success of this form of therapy.

Etiology—With few exceptions the disease is found almost solely in negroes. Both males and females are affected the former somewhat more commonly.

The exact mode of infection has not been determined but the location suggests a direct contact with an infected person. It is more common in southern and tropical countries, notably South America and Australia but is also endemic in the United States. It has here been reported in coastal regions both North and South. Randall believes that it has been prevalent in Philadelphia for more than the past twenty five years.

The specific organism originally described by Donovan²² in 1900 is considered pathognomonic of the disease although it is not always demonstrable. The organism is a Gram negative non motile non sporulent encapsulated bacillus.

Smears can be made from the granular tissue after removing the surface exudate with sterile gauze. A cotton swab or wire loop may be used. A thin spread on the slide is essential. The Wright or Giemsa method of staining is used.

The organisms appear as small rounded pinkish bodies with a dark blue coccoid body in the center. The pinkish outline is due to the presence of a wide capsule and this must be decolorized to obtain the true outline of the body proper. These organisms are found in the cytoplasm of large mononuclear cells. At times they are said to appear in nests without capsules and presenting a bipolar stain. Non-encapsulated forms occur in the polymorphonuclear cells.

Secondary organisms are few in number compared with the usual smears from other ulcerative conditions about the genitalia.

The organisms do not liquefy gelatin or coagulate serum. Freshly isolated cultures hemolyze blood. Milk is coagulated and acidified. Indol is not produced. All the common sugars are fermented. Dulcitol and rice starch are not. These organisms grow luxuriously on all

tion in some cases. Hyperemia induced after the method of Bier by means of a bell glass is admirable to promote resolution and hasten softening. During recent years the application of through-and-through heat by means of diathermy has given the most satisfactory results either by causing resolution or by hastening the softening of the glands. The common practice of painting the parts with tincture of iodine has little or no value.

Surgical — This treatment should be withheld until the bubo has softened and there is fluctuation, then simple incision at right angles to Poupart's ligament offers the best method of drainage. The wound is wiped dry and packed with iodoform gauze. Frequent swabbing with tincture of iodine and dressing with wet or dry gauze offer the best means of causing resolution.

Except for the management of chancroid itself, no other condition has received so many diverse forms of treatment. Complete extirpation of the glands is a favorite method of radical cure, but unfortunately being septic in the beginning, these wounds do not heal kindly, and occasionally grave complications arise from wounding of deep-seated blood-vessels and lymphatics.

Frequently the chancroidal adenitis may be complicated with the indolent adenitis of lues, and here the application of prompt and energetic specific treatment, as a rule, causes rapid resolution.

Phagedena as a complication of adenitis calls for heroic treatment. The patient is best anesthetized, and with the actual cautery all infectious and necrotic tissue is removed, subsequently the ulcers are treated with hot dressings and tincture of iodine irrigations.

4 GRANULOMA INGUINALE

Granuloma inguinale is a non-inflammatory disease affecting the skin of the groin, prepuce, perineum and vulva. It is characterized by the development of a small papule which, after rupture, persists in a slow proliferation of granular tissue without tendency to local healing.

Historical — The earliest and most complete study of this condition was made by Aragao and Vianna,²⁷ of Rio de Janeiro. The disease has been present in the tropical countries for many years and yet has been described as a distinct entity only during the past decade. More recently the presence of this disease within the United States has been noted by Symmers and Frost,²⁸ Randall, Small and Belk,²⁹ and others.

Since Howard Fox's report (1926) of 150 cases of granuloma inguinale in the United States, there has been an increasing number of patients treated in the various clinics. According to Hazen, Howard, Freeman and Scull,³⁰ granuloma inguinale is of frequent occurrence among the negroes of Washington, D. C. Nine patients were treated in the Freedmen's Hospital Clinic, Washington, during the period of one year, these patients represented 1 per cent of the total number of new patients

Pathology — "Stained sections of granuloma inguinale show a superficial cellular area surmounted on a base of dense, hyaline, connective tissue. The transition is rather sudden but no distinct line of demar-

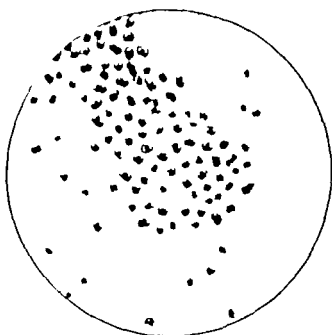


FIG. 145 — Preparation from acid dextrose agar culture. Wright's stain. $\times 1700$. Capsules stained, typical morphology. (Randall Small and Belk.)

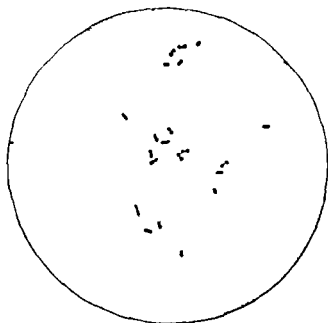


FIG. 146 — Young broth culture. Wright's stain. $\times 800$. Bipolar staining and solid staining of organisms. No capsules. (Randall Small and Belk.)

cation separates the two elements. The cellular area is composed of young connective tissue relatively small in amount, many endothelial leukocytes, and a smaller number of polymorphonuclear

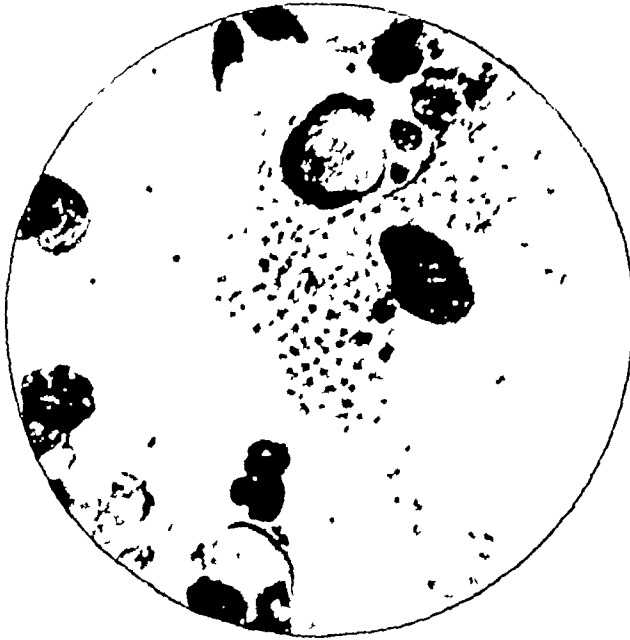


FIG 143 —Smear from lesion, Wright's stain $\times 800$ Donovan's organisms in and about mononuclear cells. A rounded "nest" of non-encapsulated organisms appears in the disintegrating cytoplasm of one of the cells (Randall, Small and Belk)

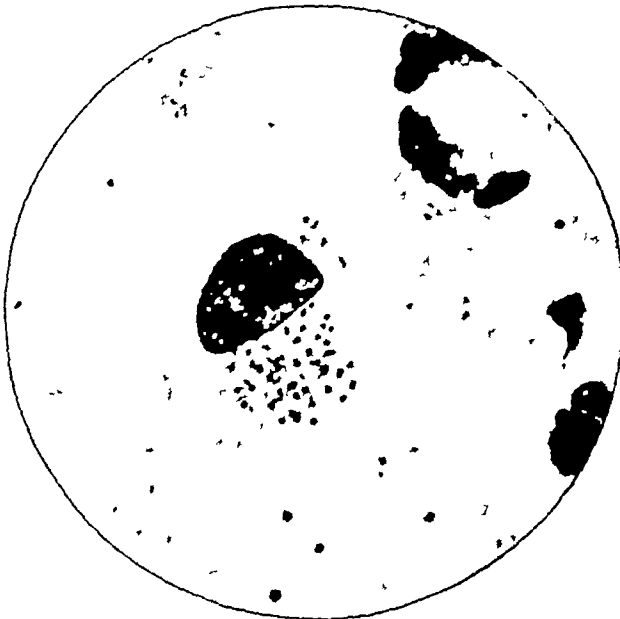


FIG 144 —Smear from lesion, Wright's stain $\times 1200$ Intact mononuclear cell showing cytoplasm studded with Donovan's organisms—capsules narrow or absent (Randall, Small and Belk)

the ordinary culture media and are favored by an acid reaction. The colonies appear as grayish-white, translucent, glistening, dome-shaped elevations on round regular bases from 1 to 3 mm in diameter. They are not unlike the surface growth characteristic of the Friedlander bacillus.

PLATE VI



Granuloma Inguinale.

(Colored photograph and case history kindly furnished by
Dr. Alexander Randall.)

neutrophiles The proportion of the latter varies considerably, appearing most numerous in untreated cases They are probably an index of secondary infection Many lymphocytes are also present and an occasional eosinophile Blood-vessel formation is present as in any active granulation tissue At the margin of the granulation, the squamous epithelium of the skin is seen partially destroyed and replaced Further out this merges into normal skin, under which, however, the subcutaneous tissues are infiltrated for a little distance by round cells This would indicate that the lesions extend somewhat farther than would appear on superficial inspection of the granulating area A feature worthy of note is the proliferation of squamous epithelium near the edges of the granuloma, where finger-like projections extend for some distance into the deeper tissues In some cases this suggested a squamous-cell carcinoma"—(Randall, Small and Belk)

Symptoms—*Subjective* symptoms are few The irritation of the denuded surfaces from the pressure of clothing is usually the only complaint of pain The granuloma is not painful to the touch and only severe irritation will cause pain

Objective symptoms the lesion starts as a small papule, which after rupture and the exudation of slightly purulent fluid, refuses to heal and spreads slowly A resultant overgrowth of reddish-pink, exuberant granulation tissue occurs It is not at all like an ulcer, as the edges are redundant and overlap the apparently healthy skin margin There is a scanty exudation, mucoid in character, which is practically odorless (Plate VI)

On the larger flat skin surfaces, the older lesions show a tendency toward cicatrization in some areas but continuing to spread in others

The most frequent location is in the groin Spreading occurs upward as far as the anterior-superior spine and downward through the fold of the groin, often involving the perineum, prepuce, anal region and buttocks The glans and shaft of the penis may become extensively eroded

In the female the labia majora are most acutely affected, although the groin is also involved Extension may occur into the rectum and vagina and enormous swelling of the entire vulvo-perineal region frequently results.

Noticeable secondary anemia is present in most cases There is an absence of leukocytosis, eosinophilia, or other cellular or plasma tests of the blood

Diagnosis—The diagnosis is based upon the characteristic clinical picture and the bacteriological finding of the specific organism The therapeutic result from the use of antimony intravenously may also be regarded as an indication of the accuracy of the diagnosis

Chancroidal sores can be differentiated by their ulcerated, undermined edges and the presence of their foul purulent discharge

Tertiary syphilis is the most difficult to rule out Condylomata acuminata and condylomata lata resemble the granuloma closely when the latter occur about the anus

Tuberculosis cutis has been a most frequent diagnosis for granuloma inguinale.

The possibility of mixed infections of granuloma and syphilis or chancroid must be borne in mind. In those cases in which the Wassermann test is positive, a double infection undoubtedly exists. Prostatic and gangrenous balanitis must be excluded.

Any sore occurring in the groin perineum or genital region which is resistant to ordinary antiseptic or intravenous arsphenamine should be examined for the specific organism of granuloma inguinale.

Prognosis and Treatment.—Until the advent of antimony therapy the treatment of these lesions was very disappointing. Salves escharotics and antiseptics have no value vaccine therapy is useless, excision leads to recurrence, arsenic is of no benefit roentgen ray brings about a slow but inconstant healing which is prone to recurrence.

Under antimony therapy the prognosis is extremely good. This is given in the form of tartar emetic. Intravenous administration is essential. The initial dose is given as 0.04 gm. and this is progressively advanced to a maximum dosage of 0.10 gm.

Injections may be given daily or less frequently the symptoms of intolerance for the drug being the guide. Intolerance consists of rheumatoid pains in the joints associated with stiffness.

The drug is prepared by dissolving the powder in sterile normal saline solution and is best preserved in sealed sterile ampoules.

The typical organism disappears from the surface and cannot be found in smears after the third or fourth injection. Healing promptly follows.

The amount of drug administration necessary to effect a cure varies apparently with the extent of the lesion. According to Vianna, it is advisable to continue injections at weekly intervals for from three to four months after complete healing has occurred.

Greenwood²⁸ has analyzed the treatment of 22 cases of granuloma inguinale by thermo-electric coagulation (he uses the term fulguration) the technique of which was as follows. General anesthesia was used in all but one case. The electrocoagulation was confined to the edges of the ulcer in each case and no attempt was made to treat the base. This limited treatment was not based on the pathology of the disease which appears to be somewhat confused but on a hope that the virulence was confined to the edges and on a desire as far as possible to avoid shock. Shock did not occur in any of the cases, but the success of this limited treatment made it unnecessary to attempt any extension. The edges of the ulcer however were dealt with drastically the thick spark was applied first to the external aspect, i. e. on the unbroken skin where it rises to meet the growing edge second to the junction of the skin and ulcer and finally to the edge of the ulcerated tissue inside of this. After that a careful survey of the area treated was made to make certain that there was no interruption of the line of desiccation. Any gap in the line however small was retreated. This inspection seems to have been a very important point, as it is easy to

Nomenclature—Lymphogranuloma inguinale is the term commonly used to describe the disease in this country. The condition however has been reported in the literature under various names. The disease described as *climatic bubo* (Goddard³⁹ 1890) although recognized by Trousseau⁴⁰ in 1865 and by Klotz⁴¹ in 1890 as *strumous buboes* was no doubt an example of this clinical entity. Since the publication of the article by Durand Nicolas and Favre⁴² in 1913 in which they grouped their cases under the title of *lymphogranuloma inguinale subaigue* and their subsequent contributions the disease has been referred to as *Durand Nicolas and Favre's disease subaigue inguinal poradenitis* (Destéfano and Vaccarezza⁴³ 1923) *non-tuberculous granulomatous lymphadenitis* (Hansmann⁴⁴ 1924) *lymphopathia venerea* (Sulzberger and Wise,⁴⁵ 1932) *fourth venereal disease* (Cole,⁴⁶ 1933) and *sixth venereal disease* (Stannus⁴⁷ 1933).

The similarity of the name lymphogranuloma inguinale to granuloma inguinale and lymphogranulomatosis cutis (Hodgkin's disease) is confusing but these represent entirely distinct clinical entities.

Historical.—The first important historical event associated with this disease was the grouping of the cases as a recognized clinical entity by Durand Nicolas and Favre (1913). They classified the condition as an independent, infectious entity occurring in males and characterized by a definite clinical picture. The description and demonstration of a specific intradermal test by Frei⁴⁸ in 1920 (the Frei test) served to separate these cases still further and to establish more firmly the distinctness of the clinical entity. The demonstration by Hellerstrom and Wassen⁴⁹ (1930) that an ultramicroscopic virus found in the suppurating buboes could be transmitted to and passed in monkeys by intra-cerebral inoculation was another epochal contribution in the progress of our knowledge of this disease. Jersild⁵⁰ (1930) described the disease occurring in females associated with involvement of the superficial and deep lymphatics and called this combination the genito-anorectal syndrome of lymphogranuloma inguinale.

The increasing number of clinical reports of lymphogranuloma inguinale in this country in addition to the vast foreign literature have served both to increase our knowledge and to widen the variety of clinical pictures produced by this disease in the male and female in all races. Among the important contributions on this condition in the American literature have been those of Pardo-Castello⁵¹ Hillsman Wilshusen and Zimmerman⁵² De Wolf and Van Cleave⁵³ Cole Wise and Sulzberger Wien and Perlstein⁵⁴ Bloom⁵⁵ and others.

Etiology—The specific etiological agent of lymphogranuloma inguinale has not as yet been demonstrated. A considerable amount of experimental work has been done by Levaditi,⁵⁶ Findlay⁵⁷ and others. The evidence presented by the published reports indicates that lymphogranuloma inguinale is due to a filterable virus. The disease has been successfully transmitted to apes by subdural injections and has the characteristics of an encephalitis. Hellerström and Wassen have shown that the virus rapidly loses its virulence in glycerin but that the viru-

leave a small area untreated, and if this is done, recurrence at that point is probable. In many cases isolated healed areas occurred in the base of the ulcer, and the edges of these were desiccated as a precautionary measure. At the completion of the electrocoagulation a dressing of boric ointment was applied and left on for twenty-four hours.

The manner in which the ulcer heals is rather unusual. By the seventh day the desiccated area has usually separated, the process beginning about the third day, and a dull reddish margin is left. No ingrowth of the skin occurs, but about the end of the second week a firm, tough, and rather leathery scar covers the ulcer.

Greenwood's summary of his treatment of 22 patients between March, 1927 and June, 1929 reads as follows:

"Summary 1 The method of treatment described in this paper is, I believe, a new one. 2 The treatment is easy to carry out, is not attended by shock, and, given general anesthesia at the time of operation, causes practically no discomfort to the patient. 3 The average time taken to heal the ulcer in this series of cases was seventy days, the greater part of the ulcer being healed in most cases in about four or five weeks. This is a very much shorter period than that taken by the antimony tartrate treatment in most cases. There were no failures in the series. 4 Judging from the appearance of the scar and from the one follow-up case seen, it seems probable that the cure is lasting. 5 The fact that treatment of the edges of the ulcer only is sufficient goes to confirm the work of Castellani and Mendelson, (*Journal of Tropical Medicine*, 1929, 1, 6), that the Leishman-Donovan body, found *only in smears* from the ulcer, is not the causative organism, but a nosoparasite. It also seems to indicate very strongly that the true causative organism should be looked for in the active edges of the ulcer. 6 All the patients in this series were treated by me in Malaya, and any true estimate of the value of this treatment must await the results of other workers in other countries, as it is possible that there may be variations not only in the extent but also in the type of the disease."

5 LYMPHOGRANULOMA INGUINALE

SIXTH VENEREAL DISEASE

By MAX S. WIEN, B.S., M.D.

Definition—Lymphogranuloma inguinale is a disease entity which occurs in both sexes and is characterized by inflammation of the inguinal glands secondary to a primary lesion on the genitals. There may be involvement of the associated structures in the pelvis by direct or retrograde infection of the draining lymphatics leading to the formation of the genito-anorectal syndrome. There may also be associated constitutional symptoms in the various stages of the disease.

primary lesion occurs on the mons or the upper part of the vulva (Fig. 149). The nodes become fused because of the periadenitis in

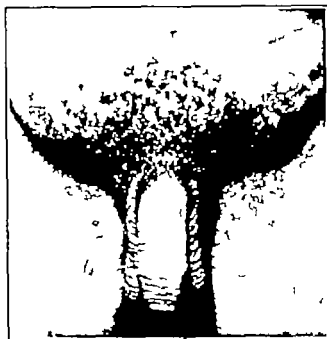


FIG. 148.—Bilateral inguinal adenitis before ulceration has occurred

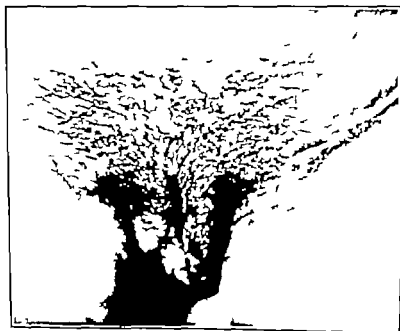


FIG. 149.—Suppurative inguinal adenitis in the female associated with vulvar and perineal lesions.

duced by the disease. The overlying skin becomes tense and adherent as the underlying gland enlarges and there may be involvement of the contiguous subcutaneous tissue. The glands vary in size from that

lence may be preserved in the frozen state for at least twenty-one days Tamura⁵⁸ reports the successful cultivation of the virus in tissue-Tyrode medium, and the use of heated cultures for diagnostic (Frei) tests and intradermal treatment

Symptoms —The disease first manifests itself by the appearance of a primary lesion (Fig 147), usually on the genitals of the male or female following sexual relations Extragenital lesions have been described by Curth⁵⁹ and by Bloom⁶⁰ which occurred on the tongue and the tonsil accompanying cervical buboes The disease has been contracted by a surgeon as the result of accidental inoculation of the finger and in children by simple contact



FIG 147 —Primary lesion on the penis *

After an incubation period varying from three days to three weeks, the primary lesion, which may be transitory and unnoticed, appears as a small, painless papule or herpetic process on the glans penis or in the coronal sulcus The primary lesion may give rise to a urethritis because of an intra-urethral localization In the female the primary lesion is usually on the vulva but may appear in the vagina or on the cervix There may also be a localization of the primary lesion in the perianal region

After a second incubation period averaging between two and three weeks following the appearance of the primary lesion, the limits being between a few days and six or eight weeks (Stannus), the satellite lymph glands which drain the site of the primary lesion became involved (Fig 148) A lymphangitis occasionally occurs and a thickening of the dorsal lymphatics of the penis has been reported by Hellerstrom,⁶¹ Bory,⁶² Nicolau and Banciu,⁶³ and Goldstein and Byars⁶⁴

The inguinal lymphatics are the regional glands most commonly involved in the male with a penile lesion and in the female when the

*All the illustrations in this article are from the author's collection of cases

tiasis and sclerosis of the vulva anal region and the rectal wall with the associated production of anal fistula and rectal stricture (Fig. 152). These conditions were subsequently described by Fournier⁴⁴ in 1875 as



FIG. 151 — Fathlomi's



FIG. 152 Genito-anorectal lesions in the patient presenting inguinal lesions (Fig. 149) showing anal bouquet and puckered fibrous scarring.

"syphilome anorectal" but today we know that the majority of these cases are associated with a positive Frei test and that the syndrome is produced by lymphogranuloma inguinale. In addition there may be

of a hazelnut to that of a fist and may be involved singly or in chains, usually bilaterally. Central softening with suppuration takes place with the formation of a number of indolent, discharging fistulous tracts and the production of multiple skin abscesses. There is a tendency to a cord-like involvement of the regional glands with a parallelism of the fistulous openings (Fig 150).

Constitutional symptoms may be associated with the above sequence of events, and the type and severity of the symptoms may be quite variable. Fever, malaise, anorexia, loss of weight, local pain, rheumatoid pains and an eruption of the erythema multiforme type with lesions which may simulate erythema nodosum have been observed. In the male there may also occur as a result of the blocking of lymph spaces, caused by the inguinal adenitis and associated involvement of lymphatic tissue, an elephantiasis of the penis and scrotum.



FIG 150 —Chronic suppurative inguinal adenitis in the male showing the parallelism of the lesions with fibrous, puckerred scarring

The clinical syndrome of lymphogranuloma inguinale in females was classified by Ravaut, S  n  que and Cachera⁶⁵ into three types (1) anorectal elephantiasis, (2) rectal stenosis and stricture and (3) pelvi-metritis with secondary rectal stricture.

The first stage in this sequence is esthiom  ne (ulcus vulv   chronicum elephantasticum). Frei and Koppel⁶⁶ in 1928 called attention to the frequency of the occurrence of positive Frei tests in esthiom  ne. In these cases the primary lesions of lymphogranuloma inguinale occur on the vulv   with secondary drainage to the superficial lymphatics, followed by stasis and finally by elephantiasis of the vulv   (Fig 151).

In some cases there may be the additional clinical and anatomical involvement of the deep lymphatic glands, or the latter glands may be involved alone. The combined involvement of the superficial and deep lymphatics has been described by Jersild and called the genito-rectal syndrome. This condition, described by Huguier⁶⁷ in 1848, consisted of a chronic ulceration of the vulva associated with elephan-

Sulzberger and Wise Cole and his co-workers, Fischer Schmidt and La Baume,⁷⁷ and Bloom and further substantiated by the recent report of necropsy findings in these cases.⁸⁰

In some instances the rectal lymphopathia does not develop a healing reaction of fibrosis but instead continues on to ulceration with a breaking down of the glands, and discharges into the rectum, resulting in an ulcerative proctitis. In many cases there is also a perforation of the recto-vaginal septum with resultant fistulae. This is the sequence seen in the advanced stage of the genito-rectal syndrome as described by Roegholt.¹⁴ The clinical symptoms associated with ulcerative proctitis may so undermine the patient's health and nutrition that a profound cachexia results, terminating in death. The symptoms seen at this stage are not unlike those seen in the terminal stage of cancer of the rectum and must be differentiated therefrom.

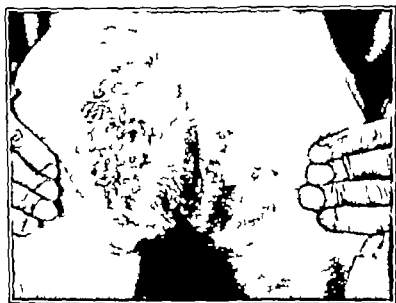


FIG. 154.—Anorectal syndrome in the male showing perianal suppurative lesions and anal bouquet.

In males there may be an associated infection of the perirectal glands with the development of the genito-anorectal syndrome (Fig. 154).

Frei Test and Anergy—The Frei test, described by Frei in 1925, has served greatly in the identification of this group of cases by means of the specific intradermal reaction. The preparation of the antigen and the interpretation of the test require care. Pus is withdrawn from a gland which has softened but which has not opened or been exposed to external contamination. The pus is withdrawn by aspiration with a syringe and a large bore needle under sterile conditions. Blood-free pus should be obtained. The pus is then mixed with from 6 to 8 parts of sterile physiological saline solution and heated on a water bath at 60° C. for two hours and on the following day at 60° C. for one hour.

extension to the adjacent lymphatics in the skin of the buttocks and perineum, with the production of localized, soft, granulomatous masses, some of which may ulcerate (Fig 153)

When the primary lesion occurs intravaginally or on the cervix, the lymph drainage is to the pelvis and a perirectal lymphadenitis develops with infiltration of the perirectal tissue and rectum and extension to the recto-vaginal septum, and occasionally to the adnexa. With involvement of this type there is a definite sequence of symptoms. Following the primary cervical or intravaginal infection, there is involvement of the anorectal glands, which suppurate, and finally result in an inflammatory stenosis of the rectum with clinical symptoms of rectal obstruction. According to Barthels and Biberstein,⁶⁹ this



FIG 153 —Lymphogranuloma inguinale of the buttocks, showing ulcerative draining sinuses, boggy swellings and puckered scarring

obstruction usually occurs about 2 to 6 cm from the anal sphincter because of the anatomical position of the anorectal glands. This primary stage of the genito-rectal syndrome has been described by Nicolas, Favre and their co-workers,⁷⁰ Bensuade and Lambling,⁷¹ Sulzberger,⁷² and others.

This condition may continue for a variable period, and, as a result of the slow but progressive fibrosis associated with the healing process in the affected lymph glands, result in rectal stricture. Many of these cases of rectal stricture have previously been classified on a syphilitic or benign new-growth basis, even in the absence of laboratory confirmation for these diagnoses. The advent of the Frei test has clarified the diagnosis in many of these cases and definitely established them as a phase in the genito-rectal syndrome of lymphogranuloma inguinale. This opinion has been held by Nicolas, Favre and their co-workers, Frei,

that in lymphogranuloma inguinale the condition of anergy may be seen when there is only an elephantiasis vulvae et ani a rectal stricture occurring many years after a primary infection in coincidental florid syphilis or in the premenstrual state. Hellerström⁷³ adds that in cachexia there may be an absence of allergy to the Frei test. Hermans⁷⁴ states that a negative Frei reaction in some of these cases can be explained by the existence of two types of antigen. He feels that the patients



FIG. 156.—Rectum and perirectal tissue removed at autopsy. Showing chronic ulcerative proctitis and periproctitis. A Rectovaginal fistula B perirectal abscess C rectal ulceration.

with their respective antigens can be divided into two groups without reference to their clinical manifestations. The first group does not react to vaccine prepared from the second group but the second group reacts to both vaccines and represents the majority of cases.

Pathology—Gross and microscopic studies of the primary lesions and of the affected glands have been made by many writers and recently reviewed by Wien, Perlstein and Neuman⁷⁵. In the cases studied the affected lymph nodes were matted together and macroscopically small abscesses filled with a yellow-green thick pus were

If the material is heated to 80°C a much less active antigen is obtained. The material is then tested for sterility. The antigen should give a negative reaction in controls. A preservative may be added and the antigen kept in an ice-box when not in use. It may be kept in a special rubber-stoppered bottle, such as is used for vaccines, or put in 0.5 or 1 cc. hard-glass ampoules.

To perform the Frei test the skin on the flexor surface of the forearm is cleansed with alcohol and 0.1 cc. of the antigen is injected intradermally, a similar amount of normal saline solution may be injected into the other arm as a control. The result is then read after forty-eight hours, any reactions which occur before that time being pseudo-reactions. A positive reaction consists in the development of an inflammatory, dome-shaped area, 0.5 cm. or more in diameter which has a central infiltrated papule (Fig. 155). The central infiltration is an

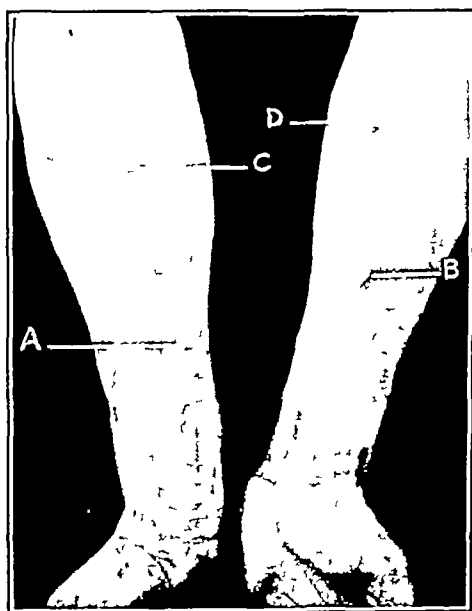


FIG. 155 — Results of positive Frei test. A, forty-eight hour old papule, B, one week old papule, C, two week old lesion, D, three week old lesion.

essential part of the reaction. In some cases the central area may undergo necrosis or pustule formation.⁷⁵ This allergic skin reaction develops quite early in the course of the disease and the sensitivity lasts for many years.

Nicolas, Favre and Lebeuf⁷⁶ state that skin allergy in lymphogranuloma inguinale has great diagnostic significance, but is not 100 per cent positive. The reaction may be negative occasionally in fully developed cases owing to anergy. Frei⁷⁷ in 1932 stated that a negative skin reaction does not rule out lymphogranuloma inguinale, but that a positive reaction occurs only when there is an intensive glandular reaction with involvement of the overlying skin. He further states

chaneroidal lesion. The absence of polycyclic grouping, lack of induration, absence of the *Spirochæta pallida* on dark-field examination and the absence of the bacillus of Ducrey respectively should serve to differentiate it from the conditions enumerated. The intra-urethral lesion associated with urethritis might be confused with a gonorrheal infection or an intra-urethral chancre.

The non-suppurative, discrete, small character of the adenopathy in syphilis associated with a positive dark field, positive blood test and the findings of spirochetes on examination of the gland puncture fluid by dark field should serve to rule out syphilis.



FIG. 157.—Photomicrograph of section of rectal wall showing transition from columnar to stratified squamous epithelium. (X 220.) Hematoxylin and eosin.

In chancroid the adenitis is usually unilateral, the gland abscess is usually large and single, the bacillus of Ducrey may be found on a smear of the discharge from the primary lesion, the Ito-Reinstiterno and dmelcos reactions are positive and the lesions are auto-inoculable.

Granuloma inguinale is primarily a disease of the skin in which one finds a beefy red, moist proliferation of the inflamed tissue with the occasional association of a somewhat verrucous elevated border. The disease spreads peripherally with a tendency to healing in the center and the production of firm, whitish, sometimes keloidal scar tissue. It may spread by contact to the inside of the thighs or the perineum or up into both groins. The examination of a smear from the ulcer or a specimen of tissue, the under surface of which is pressed out on a glass slide and stained as for a blood smear with Wright's or Giemsa's stain may reveal the Donovan inclusion bodies which are characteristic of this condition.

usually seen. These nodes showed suppuration and never caseation, thus being differentiated from tuberculosis. The histological picture in the main revealed small discrete and ramified abscesses surrounded by zones of epithelioid cells, often in palisade arrangement. In the abscesses there was a granular detritus. The lymph node structure was almost entirely substituted for by a granulation tissue composed of plasma cells, lymphocytes, epithelioid cells, fibroblasts with an occasionally multinucleated giant cell of the Langhans type, usually bordering the epithelioid cells. The cellular infiltration was quite marked about the lymphatics and many of the newly formed blood-vessels showed some thickening of their walls.

Autopsies in this condition, in which antemortem diagnoses have been made, are extremely rare. Hillsman, Wilshusen and Zimmerman and Wernich⁸¹ report autopsy observations in the male. Autopsies in the female have been recently reported by the author.⁸⁰ The gross changes in the rectum usually consist of numerous transverse ulcerations separated by swollen and injected mucosa (Fig 156). Some of the ulcers are deep and extend into the indurated perirectal tissue. The histological examination showed the mucosa to be densely infiltrated by plasma cells and lymphocytes, between which were occasional histiocytes and polymorphonuclear leukocytes. The submucosa was much thickened and fibrosed and contained many perivascular accumulations of plasma cells and lymphocytes. The walls of the smaller arteries were thickened, especially the intima, while the small veins were wide and their walls were infiltrated by plasma cells and lymphocytes. The muscularis was usually hypertrophic and about the larger blood-vessels there was an increased amount of connective tissue. The capillaries of the muscularis were prominent owing to a swelling of their endothelial and adventitial cells and about them a few histiocytes and plasma cells were frequently seen. Occasionally, the normal epithelium had undergone a metaplasia to a squamous epithelium (Fig 157). This squamous epithelium lined and filled the glands. Many of the epithelial cells were large and clear, with prominent cell membranes. Plasma cells were scant. The infiltrations extended into the deeper layers of the wall and followed the blood-vessels. In the islands between the ulcers, the mucosa was thin and cellular. The normal epithelium was substituted for by squamous epithelium cells which lined and filled the glands. Many of these epithelial cells were large and clear and the cell membrane was prominent.

Diagnosis and Differential Diagnosis—The occurrence of a subacute inguinal adenitis without a history of a primary lesion or with a history of a lesion on the genitals usually located on the coronary sulcus, of short duration, followed by an adenitis that goes on to suppuration with periadenitis and fistula formation should make one suspicious of lymphogranuloma inguinale, and a Frei test should be made to establish the diagnosis.

The initial lesion of lymphogranuloma inguinale is small and painless and may suggest a herpes proies, an erosive chancre or an early

advocated by many, but in the cases under our observation the reaction to surgical excision of the affected glands has been a variable and unfavorable one. Our experience with patients with the late sequela of lymphogranuloma inguinale has been that they are exceedingly poor surgical risks and will usually succumb to any major operative procedure. However if the patient is previously fortified with a series of intradermal antigenic treatments conservative surgical management as indicated can be safely instituted.

The use of roentgen-ray locally (filtered and unfiltered) ultra violet light and the injections of various chemical and biological agents is detailed in the monographs and in the literature with variable and in most instances inconclusive therapeutic response.

We have used since January 1932 a therapeutic measure which has given uniformly good results in our hands and in the hands of some of our colleagues. The treatment of lymphogranuloma inguinale with the intradermal injection of Frei antigen² has resulted in a decided clinical improvement of both a somatic and local nature in practically all our cases. One-tenth cubic centimeter of the antigen is given intradermally at intervals of from three to five days and an infiltrated papule forms at the site of each injection within forty-eight hours. The intensity of the Frei reaction does not vary with successive injections. A marked local reaction however sometimes occurs at the site of treatment so that successive injections are made at remote sites. We have also observed a reversal of the Frei reaction to negativity in 3 patients after each had received an average of 11 injections of the antigen into the forearm given at intervals of three days. The results of the tests in these instances were negative irrespective of the type of antigen used. Simultaneously with the negative results obtained on the forearms, positive results were obtained when the same Frei antigen was injected intradermally into the buttocks or into the backs of the same patients. After a rest period of from two to three weeks positive Frei tests were obtained on the forearm. We feel that the negative Frei tests in these instances were dependent on a temporary local desensitization of the forearm.

In all the patients there was a decided clinical improvement immediately after the earliest injections: new lesions ceased forming, the sinuses stopped discharging and healing and fibrosis were hastened. In the patients with the anorectal syndrome there was alleviation of the rectal symptoms with improvement in the general condition.

The advantages of intradermal injections of Frei's antigen in the treatment of lymphogranuloma inguinale are that less antigen is required and the beneficial results are obtained in a shorter period of time than with the subcutaneous method. We have had no experience with the intravenous method described by Gay Prieto³. The intradermal method does not require any specially prepared antigen and there is no constitutional reaction such as was noted by the foregoing authors after the first injections in their patients.

Treatment must be continued for many months if a good result is to be obtained.

Non-specific septic infections of the inguinal glands may follow septic lesions of the genitals, feet or legs and give rise to diagnostic confusion. This condition is usually acute in onset, associated with fever, acutely tender and more painful than the adenitis in lymphogranuloma inguinale and septic organisms can be demonstrated. The Frei test is negative unless there has been an antecedent infection with the virus of lymphogranuloma inguinale. The possibility of double infections must always be borne in mind.

Tuberculosis of the inguinal glands may closely simulate the chronic indolent adenitis of lymphogranuloma inguinale, but a negative Frei test, the finding of acid-fast bacilli on smear of the gland pus or in the stained histological section of the gland and positive guinea-pig inoculation should serve to establish the diagnosis of a tuberculous adenitis. The finding of a latent or manifest focus of tuberculous infection will further serve to aid in this diagnosis.

Secondary carcinoma of the inguinal glands, actinomycosis, Hodgkin's disease, sarcoma and glandular fever may be differentiated by the history, histological examination of portions of the affected glands and cultural studies of the discharge, if present.

In a case of elephantiasis of the vulva, esthiomène, granulomatous nodules about the rectum associated with rectal stricture and benign strictures of the rectum, that are apparently of inflammatory origin, a Frei test should be made to determine whether the manifestations constitute a part of the genito-anorectal syndrome of lymphogranuloma inguinale.

Prognosis —The prognosis in lymphogranuloma inguinale should be somewhat guarded. The glandular involvement with the formation of chronic discharging sinuses may follow a protracted course and be resistant to therapy. The occurrence of sequelæ giving rise to the genito-anorectal syndrome, especially in the female, may only result in a troublesome rectal stricture, but in some cases a recto-vaginal fistula, ulcerative proctitis and eventual cachexia may result, leading to the death of the patient.

Treatment —The treatment of this condition has been a varied one in the hands of the respective writers and the therapeutic response of the condition has been a quite varied and not altogether hopeful one. The number of drugs mentioned is legion, but the best results with a chemotherapeutic agent have been obtained with antimony. This may be used as antimony and potassium tartrate, a 1 per cent solution being injected intravenously twice weekly in progressively increasing doses, starting with 3 cc and increasing 1 cc at a dose up to 10 cc for a total of fifteen or more injections. Fuadin, one of the newer antimony preparations, may also be used and is given intramuscularly every two or three days starting with a dose of 2 cc and gradually increasing to a dose of 5 cc until about 50 cc have been given. Several such courses may be given. The kidneys must be carefully watched during the treatment with the antimony preparations.

Surgical excision has been practiced for a long time and is still

Treatment.—*Prophylactic*—When phimosis is present circumcision should be performed. Frequent washing of the parts should be attended to. As this condition is self-limited in the doubtful cases when there is any question of a diagnosis all treatment should be withheld. If the diagnosis is positive however simple ointments or dusting powders are satisfactory.

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B. NON-VENEREAL GENITAL ULCERS.

By B C CORBUS, M D, F A C S

1 Ulcers accompanying diabetes found on the glans penis of the male and on the vulva of the female, usually shallow without inflamed edges

2 Ulcers accompanying infectious diseases

(a) In measles, usually in little girls

(b) In diphtheria caused by the specific bacillus Rare in the male, but sometimes found on the penis In the female found chiefly on the inner side of the labia and on the clitoris In appearance like venereal ulcers, but distinguished by the bacterial findings

(c) In typhus fever, also more frequent in the female

(d) Tuberculous ulcers, rare in the male, more frequent in the female, usually secondary to tuberculosis in neighboring organs, but may be due to direct infection The ulcers are shallow, with their edges but little inflamed, showing numerous dentations The base of the ulcer is usually clear and granulating, containing small grayish nodules

3 Ulcers which are due to localization of skin diseases on the genitals

Herpes Progenitalis.—These ulcers are round or oval, with thin edges often showing the characteristic grouping of herpes, but not invariably Found in the male on the prepuce, glans, or sulcus, in the female mostly on the labia

Etiology — Predisposing Causes — This ulcer is said to be more common in those who have venereal diseases Phimosis with retained secretions and coitus are exciting factors Males and females are equally affected Bergh⁸⁴ claims that it is more frequent in women at the time of menstruation

Herpes progenitalis, like herpes found in other parts, is due to peripheral neuritis, and may depend on reflex irritation of neighboring ganglia due to local or internal secretions

Symptoms — Herpes progenitalis begins as a single lesion or in groups, like the lesions seen on the face or lips Slight burning and itching are first noticed, and the slightly red area soon shows minute vesicular points, which rapidly increase in size to that of a pin-head or slightly larger Frequently these lesions become chafed, causing rupture of the vesicles, the area becomes confluent or presents several small excoriated areas which become irritated by secretions and slight infections of ordinary pathogenic organisms

Diagnosis — In a person recently exposed sexually, presenting a confluent patch of herpes that have become excoriated, the diagnosis should not be attempted without a careful examination for spirochetes In the early cases, however, the distinct vesicles, rapid onset, and absence of glandular swelling should be conclusive

CHAPTER VII

INFECTIONS OF THE URETHRA AND PROSTATE OTHER THAN TUBERCULOSIS

BY J. S. FLOUZE, M.D.

GONORRHEA.

Prevalence of Gonorrhea.—As might be expected with a disease so commonly held in secrecy as is gonorrhea accurate statistics regarding its prevalence are practically impossible to obtain. There have however been made a number of surveys in different portions of the country within the last few years which though they admittedly represent only a part of the infection incidence are extremely illuminating. So striking are they that they should arrest the attention of all of those who in any way are interested in mankind and its welfare. They put to shame public unwillingness to view conditions as they are merely because the subject is an unpleasant one.

No disease can vie with gonorrhea so far as public neglect is concerned. Ranking perhaps, next to the common cold in frequency of occurrence it reaches into the lives of both the guilty and the innocent and leaves an untold harvest of social wreckage in its wake. Its history is as old almost as the history of mankind and down through the ages it has gathered its victims by the tens of millions. And yet, we stand as a people almost ignorant of it all ignorant, not because there are not those who would tell the truth but because a sense of false modesty or pseudomiceeness has made society at large unwilling to listen and become interested in the subject.

Because syphilis can be but seldom is, contracted from the common drinking cup it has been possible to bring that disease into public consciousness. And due to this we have travelled far in our fight against it. But no way has been found to dress its lowly companion disease gonorrhea with garments of sufficient attractiveness to fit it as a subject for the table-talk of polite society. It was given an unfortunate etymological start, for just as soon as that ending *-rhea* appears in a word the word is spoken in hushed tones. Thus, there is much merit in abandoning the term gonorrhea for perhaps, that of gonococcus disease for it does not register that feeling of distaste or repulsion that the former so commonly evokes. Surely if advance is to be made in the reduction of the number of individuals contracting this disease there must be a greater sense of public awareness to its existence. Beyond a doubt the greatest need of the day in this regard is public education and most of this education must come from the medical profession. Without an enlightened public there is little hope of any great strides toward gonorrhea prevention.

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an incubation period during which there is almost equal danger to others, that most of its transferences can be attributed. Such a group of circumstances suggests the absolute necessity of strict patient



FIG. 159.—This diagram based on 5000 clinic cases of venereal disease indicates the proportion of cases acquired at various ages. Among women the largest number was infected at the age of nineteen among men at the age of twenty-one years. Many infections are acquired by boys and girls altogether ignorant of the danger involved. (United States Public Health Service.)

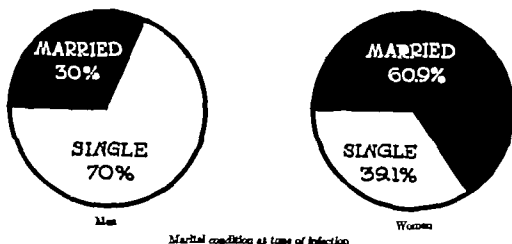


FIG. 160.—These circles represent a total of 8000 clinic cases of venereal disease. At the time of infection, 70 per cent of the men infected were single and 30 per cent were married whereas among the women the proportions were almost exactly reversed. The large percentage of women married at the time of infection suggests that the wife is not infrequently infected by her husband. (United States Public Health Service Placard.)

Since there has never been a time when there was so great a desire upon the part of the lay public to be instructed in things medical, this long neglected disease offers us one of our greatest public health challenges. Our younger generation is not greatly afflicted with that sense of Victorianism that has been responsible for the lack of public dissemination of such knowledge, and it would seem that the day has arrived wherein youth can learn the real truth about the dangers of the road ahead.

There are in many portions of our country groups of public-minded citizens who, under the name of Social Hygiene Associations, are doing what they can to combat this menace. Most of them are subsidiaries of the American Social Hygiene Association. Not only do they welcome, but they greatly need just that assistance which our profession is so able to give. It is to these groups that we owe most

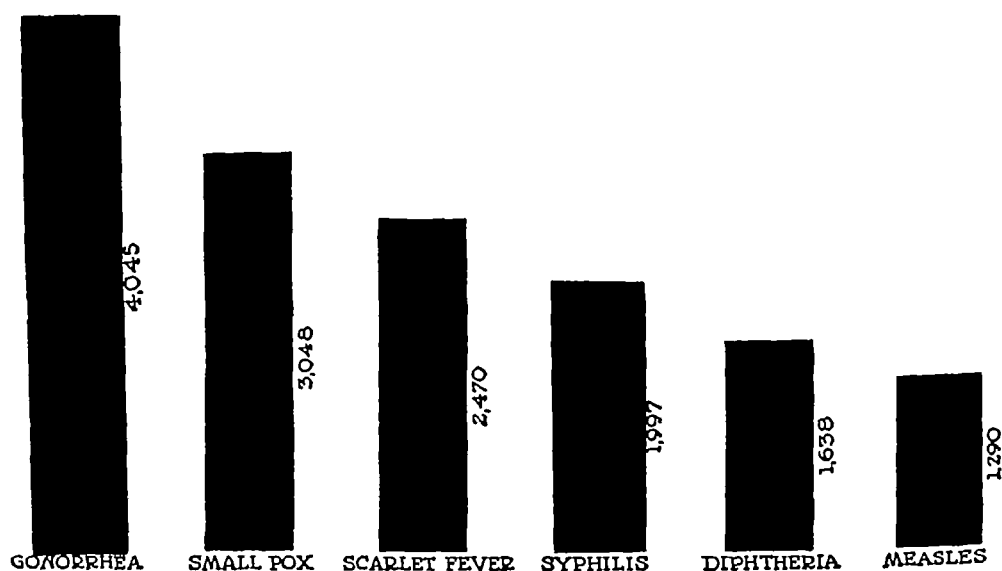


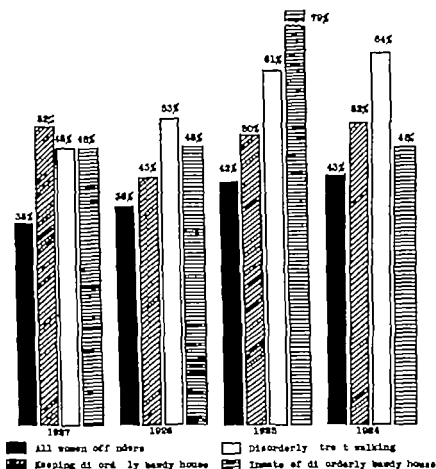
FIG 158 —The comparative incidence of Infectious Diseases Reported to The Nebraska State Board of Health (United States Public Health Service Placard)

of our present knowledge regarding the prevalence, as well as the human and economic costs of gonococcus disease. Among their other activities for human betterment they have devoted untold efforts in the fact-finding field, and it is to the results of these that we must turn if we would gather even a fair estimation of the enormous importance of the question. It is with their sanction that the following graphic charts are included (Figs 158, 159, 160, 161, 162 and 163).

Reasons for Prevalence — Aside from the appalling public ignorance regarding gonococcal infections there are many other reasons why gonorrhea is of such frequent occurrence. The very nature of the infection is conducive to its spread, for, after a period of activity, it shows a steady trend toward latency, a latency wherein the patient often is lulled into a false sense of recovery. Usually the symptoms disappear long before the gonococcus. It is to this fact, together with

greater so great in fact as to make well worth while all efforts expended toward the elimination of the evil.

Every seeming social advance is made at some cost. The so-called emancipation of woman has been bought at a terrific price for not only is gonorrhea finding its way into countless homes of a sort that rarely knew it in former days, but its age incidence in the female has been greatly reduced. Ten years ago the great problem was the girl between eighteen and twenty years. Today those institutions caring



VENEREAL DISEASES AMONG WOMEN OFFENDERS EXAMINED BY THE MEDICAL DEPARTMENT OF THE PHILADELPHIA MUNICIPAL COURT 1927 TO 1934

FIG. 162.—It would hardly be possible to find a more striking evidence of prostitution as a public health menace. (Philadelphia Hospital and Health Survey.)

for these unfortunates find their problems have to do with girls of from twelve years and over.

If we are to credit the data brought out by these Social Hygiene Surveys, another factor looms in the picture which bids fair to overshadow many of the others which we have thought more important as causes of disease spread. It has been shown that in most of our American communities at least two and a half times as many infected patients apply to druggists for treatment as apply to recognized

control until it is known the disease is cured, as well as the dissemination of the knowledge that others should not be exposed during the several days following a sexual exposure

While prostitution is still a large factor in the spread of gonorrhea it by no means holds the degree of importance that it once did. In our seaport cities and even in some of the inland communities there is still much prostitution. It however is not so much the custom for

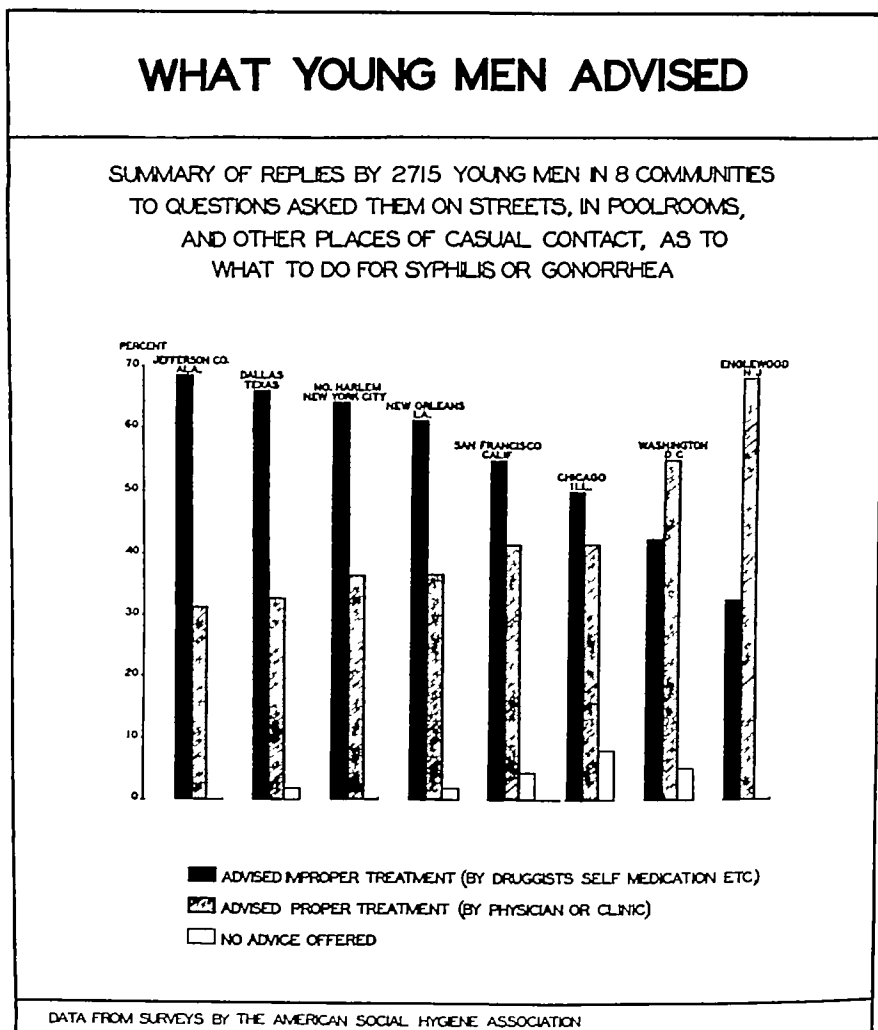


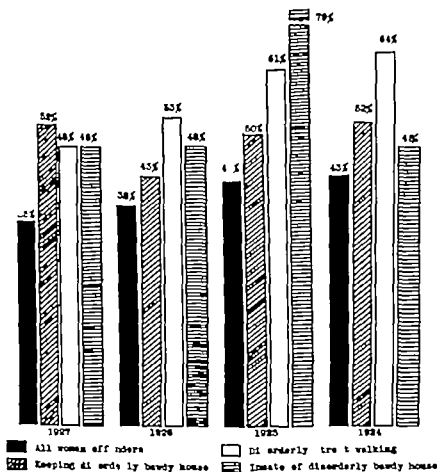
FIG 161

those of even moderate education to frequent houses of prostitution as it once was. Today prostitution has such an abundance of free competition as to have made it rather a poorly paying occupation.

Whereas twenty years ago, perhaps, 80 per cent of gonococcal infections encountered in private practice were contracted from the paid prostitute, she now does not have to stand responsible for more than 5 per cent. In dispensary practice the number of course is far

greater so great in fact as to make well worth while all efforts expended toward the diminution of the evil.

Every seeming social advance is made at some cost. The so-called emancipation of woman has been bought at a terrific price for not only is gonorrhea finding its way into countless homes of a sort that rarely knew it in former days but its age incidence in the female has been greatly reduced. Ten years ago the great problem was the girl between eighteen and twenty years. Today those institutions caring



VENEREAL DISEASES AMONG WOMEN OFFENDERS EXAMINED BY THE MEDICAL DEPARTMENT OF THE PHILADELPHIA MUNICIPAL COURT 1924 TO 1927

FIG 102.—It would hardly be possible to find a more striking evidence of prostitution as a public health menace (Philadelphia Hospital and Health Survey)

for these unfortunates find their problems have to do with girls of from twelve years and over.

If we are to credit the data brought out by these Social Hygiene Surveys another factor looms in the picture which bids fair to overshadow many of the others which we have thought more important as causes of disease spread. It has been shown that in most of our American communities at least two and a half times as many infected patients apply to druggists for treatment as apply to recognized

medical agencies Not only do they apply, but it is abundantly in evidence that most of them obtain treatment of some sort from the druggist While this is clearly illegal, it has from a public health angle a far greater danger, a danger that rates as one of our worst social menaces Not only do such patients fail to get a real diagnostic study, but they are under no intelligent control during their infectious period They are left as the sole judges of progress and cure Is there any wonder that there is so much gonorrhea? That the elimination of this unfortunate type of law-breaking is within the bounds of possibility is shown in Fig 164 wherein Washington, D C, where much attention is paid to the matter, registers only 4 per cent

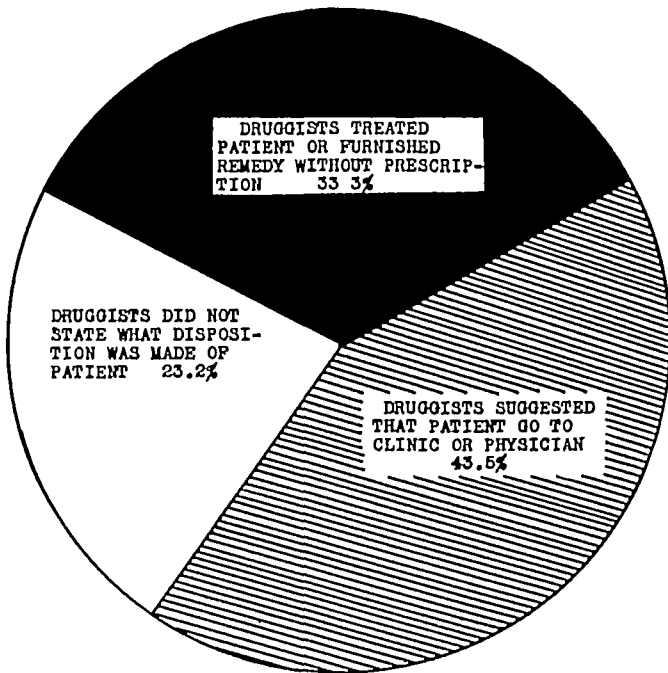


Fig 163 — Drug stores in relation to venereal diseases in Philadelphia Disposition made by 237 druggists of 2355 alleged venereal disease patients who applied to them for advice, remedies or treatment during January, 1929

Perhaps our hesitancy about starting campaigns that might appear to be a fight to gain the economic returns thus denied us, has not been too great a kindness to our fellow citizens No one who has practiced medicine very long can feel that the harm has been done alone to those suffering from gonorrhea Like conditions have been shown to exist in the campaign against the giving of active catharsis to patients presenting possible symptoms of appendicitis Back of many an appendicitis death is a bottle of citrate of magnesia prescribed by an earnest but misguided pharmacist The number of cases of secondary syphilis encountered in dispensary practice in patients whose penile sores were treated in the drug store is hardly a compliment to that trade

On the same side of the ledger might be placed the activities of

charlatans and quacks, particularly those who carry on their activities through newspaper advertising and the mails, for many of their victims are left as judges of course of action. Those with whom the patient comes into direct contact however hardly can be accused of favoring disease spread unless they do so by immediately impoverishing the patient and turning him adrift. The public menace of their existence generally takes the direction of finding disease where there

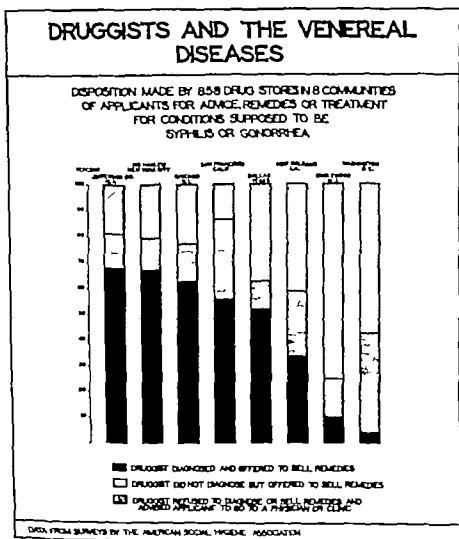


FIG. 104

is none and frightening such patients into mental fixations that entirely change their social attitude. Almost never do they allow the patient to entertain a false sense of security; their dollars lie in the other direction. As the manufacturers of our so-called sexual neurotics they hold first place among all medical and pseudomedical agencies.

The Remedy — It does not require any great amount of insight into the ways of the world today to convince one that unless action is taken the incidence of gonococcal infections is sure to increase enor

mously We have not known in this country a time wherein the sexual bias were more completely down. The idea that one's sexual affairs are his own was never more widespread The emancipation of youth from parental control, the automobile, the moving picture with its urge for youth to mimic its favorite star, the constant parade of the flimsiness of marriage vows, particularly among these highly idealized stars, contain little that is stabilizing And when and if youth looks to its elders for example it is not always so sure of finding either at home or abroad the things that elevate

Unquestionably we live in a time of changing order that bodes no good for tomorrow so far as the diseases that so often are due to sexual contacts are concerned Definitely there is a widespread moral let-down The former fear of possible pregnancy has largely been banished by the rather common knowledge of contraceptive measures, and the rather prevalent idea, particularly in the female mind, that venereal diseases belong largely to the great unwashed minimizes a mental hazard that might do much to check present trends

Religion largely has lost its hold on modern youth from the standpoint of making things attractive because they lie in the paths of rectitude and personal purity The economic hurdles barring early marriage lend their urge toward independence of action No longer are our girls reared under the protective influences that once held, but they enjoy a freedom making for the most casual of personal contacts wherein untold dangers may lurk The lurid literature of the day has done much to belie the old adage that "virtue is its own reward"

It may thus be seen that the remedy lies in so many fields beyond the province of the physician though he, as one who sees the wreckage, should interest himself in all of its angles Particularly should he grasp every opportunity for public enlightenment regarding the prevalence and dangers of this immeasurable social menace Too long has this field lain fallow

Assuredly the protection of the public health is a medical duty, and much of a constructive nature would accrue from an intelligent campaign against the unscrupulous exploitation of the infected by the charlatan and that far greater menace, drug store treatment

Regarding the infection itself in those patients who do reach the physician, there can be no doubt that he stands at the cross-road Upon what he does toward disease treatment and patient control depends the future of the patient and his possible sex contacts If he is negligent in these he often fails to break the link in a continuous chain of infection with all the human wreckage that is sure to ensue

In our efforts at disease prevention the question of prophylaxis is of extreme importance No longer is chemical prophylaxis a thing to be frowned at, but a thing of the utmost importance to every individual who presumes to expose himself to the possibility of infection Whether or not the knowledge of such protective measures encourages youth toward sexual irregularities we safely may leave to those who

view them with horror. These are not medical questions; the prevention of disease is of far more importance to us. One cannot view the results obtained by chemical prophylaxis in the United States Army as depicted in Fig. 16a without being convinced of the value of such measures.

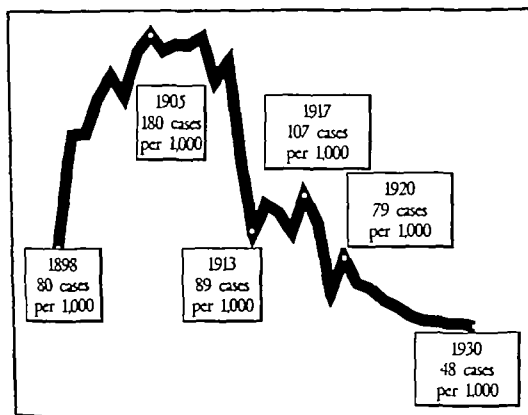


FIG. 16a.—Graphic chart showing the venereal disease incidence in the U. S. Army. The decline from the higher figures is a response to preventive measures.

The encouragement of wholesome physical and mental pursuits for youth while largely a function of social and municipal agencies, is likewise a matter meriting medical interest and endorsement. The encouragement of social hygiene agencies in all communities will do much toward public enlightenment and consequent disease prevention and in such moves the medical profession can and should play an important part.

ANATOMY OF THE MALE URETHRA.

In order to understand the course of gonorrhea in the male and apply appropriate treatment it is essential to have not only a thorough knowledge of anatomy of the urethra, but recent observations have shown that an equally accurate knowledge of its histology is imperative. For aside from immunological factors, the disease largely is influenced by the construction of the canal and its accessory glands

mously We have not known in this country a time wherein the sexual bars were more completely down. The idea that one's sexual affairs are his own was never more widespread. The emancipation of youth from parental control, the automobile, the moving picture with its urge for youth to mimic its favorite star, the constant parade of the flimsiness of marriage vows, particularly among these highly idealized stars, contain little that is stabilizing. And when and if youth looks to its elders for example it is not always so sure of finding either at home or abroad the things that elevate.

Unquestionably we live in a time of changing order that bodes no good for tomorrow so far as the diseases that so often are due to sexual contacts are concerned. Definitely there is a widespread moral let-down. The former fear of possible pregnancy has largely been banished by the rather common knowledge of contraceptive measures, and the rather prevalent idea, particularly in the female mind, that venereal diseases belong largely to the great unwashed minimizes a mental hazard that might do much to check present trends.

Religion largely has lost its hold on modern youth from the standpoint of making things attractive because they lie in the paths of rectitude and personal purity. The economic hurdles barring early marriage lend their urge toward independence of action. No longer are our girls reared under the protective influences that once held, but they enjoy a freedom making for the most casual of personal contacts wherein untold dangers may lurk. The lurid literature of the day has done much to belie the old adage that "virtue is its own reward."

It may thus be seen that the remedy lies in so many fields beyond the province of the physician though he, as one who sees the wreckage, should interest himself in all of its angles. Particularly should he grasp every opportunity for public enlightenment regarding the prevalence and dangers of this immeasurable social menace. Too long has this field lain fallow.

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ties. Fluids poured into it between urinations must remain there until urination or must force their way by their accumulating bulk through the weaker sphincter into the bladder cavity (Fig. 166).

The posterior urethra is entirely surrounded by the prostate gland the ducts from which empty into its lateral sulci and to each side of the mid line from the vesical outlet to the urethral floor. Occasionally the anterior prostatic lobe contains some follicles emptying into the roof of the urethra. Not only is the canal surrounded by the somewhat resistant prostatic substance but its wall shows a rather well marked layer of circular muscle fibers.

On the floor of the urethra is the verumontanum a mound-like spongy structure containing some glandular tissue through which the ejaculatory ducts course to their points of opening. These openings are situated near the distal extremity of the verumontanum on each side of a median slit the sinus pocularis or colliculus. This latter a pocket varying from a few millimeters to a centimeter or more in depth is the vestigial remains of the structure which in the female becomes the uterus.

Distal to the verumontanum the urethral floor presents a median ridge which varies in prominence in different individuals and terminates at the junction of the posterior and membranous urethras.

The posterior urethra which with the individual in the upright position pursues a vertical direction has been divided for purposes of descriptive orientation into a number of portions. That from the vesical outlet to the floor is called the declivity. It covers the anterior face of the median prostatic commissure. The area on the urethral floor proximal to the verumontanum has been designated the postmontane fossa. The portions lateral to the verumontanum are known as the lateral sulci and distal to it as the premontane region. The canal surface is completed by its lateral walls and the roof or anterior wall.

This portion of the canal is lined by transitional epithelial cells in close contact with the muscle layers, showing no submucous layer. All of the mucous channels emptying into it are lined by columnar epithelial cells.

From the standpoint of gonococcal infection it is obvious that the posterior urethra is a very important structure which offers very little structural protection against the spread of infection into the various small channels emptying into its lumen. Particularly is this true of the mucous reaches of the prostate gland which practically always become infected when gonococci reach the posterior urethra. To a far less degree is it so of the ejaculatory ducts wherein other factors mentioned later enter to limit disease extension to the seminal vesicles and beyond.

The posterior urethra has a rich mucosal blood supply. Contrary to general impression its nerve ends are exceedingly poor in pain sense the discomfort of posterior urethral infections being almost solely due to the trigonitis that so commonly accompanies its acute infective

and the character of the mucous membranes covering their various areas

Being a "purulent disease" there loom the important questions of barriers to the spread of infection, the possibilities for drainage and the varying degrees of susceptibility to infection and immunological response exhibited by the types of mucous membranes involved

Anatomically the urethral canal lends itself readily to division into three segments, viz—the posterior, membranous and the anterior portions

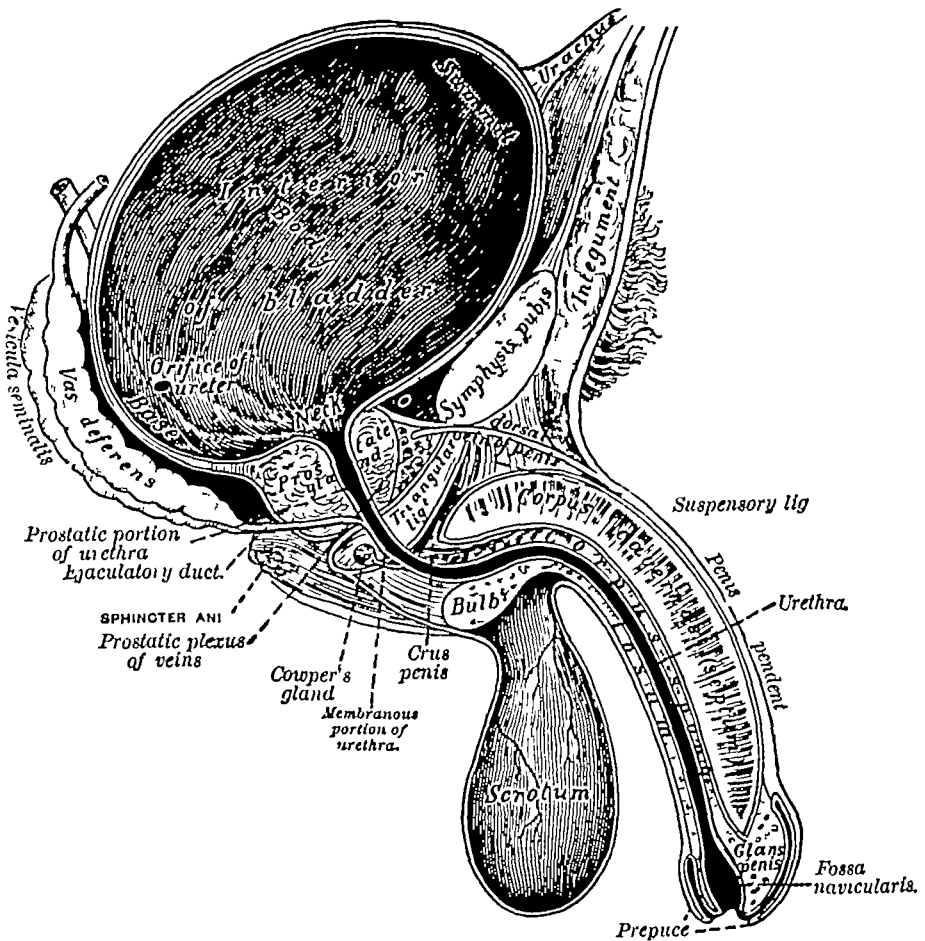


FIG 166 —Vertical section of bladder, penis and urethra (Gray's Anatomy)

The Posterior Urethra—This portion of the canal, approximately 4 cm in length, starts at the vesical outlet and extends to the posterior layer of the triangular ligament. At its proximal extremity it is, at rest, closed off from the bladder cavity by the somewhat weak vesical or internal sphincter. And its distal extremity is closed by the compressor urethræ (cut-off) muscle or external sphincter surrounding the membranous urethra, a sphincter much stronger than the vesical sphincter. It thus may be seen that, except during urination and at the moment of sexual orgasm it presents no great drainage possibi-

between the two layers of the triangular ligament, and about 1.5 cm in length, is of little importance so far as infection is concerned. Surrounded completely by the cut-off muscle it is of chief importance as a barrier to the passage of infection from the anterior urethra into the posterior structures. It has no glandular structures in its mucous membrane which usually is covered by transitional cells at times squamous cells. The mucous membrane being in close proximity to its musculature is not susceptible to stricture formation though stricture of the immediately adjacent anterior urethra is not uncommon following roughly treated gonorrhea.

As has been stated the surrounding cut-off muscle by its tonic contraction makes a directional dividing line of drainage except during urination. Pus accumulating proximal to it tends to flow back toward the bladder while that in front of it flows toward the external meatus. It is this cut-off that makes of the anterior urethra a blind canal into which fluids at low pressure may be injected and in which they may be held without escaping into the posterior portion of the canal.

The Anterior Urethra.—This portion of the canal averaging 15 cm in length extends from the anterior layer of the triangular ligament to the external urinary meatus. It is for purposes of description usually divided into three portions which are from behind forward the bulbar portion, the penile portion and the more distal centimeter the fossa navicularis. The bulbar portion, the most fixed portion of the anterior urethra, runs from the anterior layer of the triangular ligament to the penoscrotal angle. It often confusingly is spoken of as the deep urethra, a term that seems more appropriate for the posterior urethra. This is the most dilated portion of the anterior urethra and being the only portion exhibiting circular muscle fibers as well as the accelerator urinae muscles it has a function not common to the rest of the canal. By voluntary contraction its musculature expels the urine from the bulb as well as giving propulsive force to the semen in ejaculation. Being on a somewhat lower level than the penoscrotal angle this function is of much value in emptying the canal and preventing the escape of much urine into the clothing after urination. Failure of such voluntary contracture causes after-dribbling which far too often is assumed to be due to urethral stricture without further study. Because drainage from this portion of the canal is seemingly not so good as that of the penile urethra and beyond this faulty drainage was used to explain the common occurrence of stricture in the area. It is obvious, however, that tissue pressure alone assures adequate drainage from the bulb and that such strictures usually are due to the fact that the trauma of the passage of instruments during the course of gonorrhea is greater at this point. The floor of the bulbar urethra is pierced by the openings of Cowper's glands (Fig 168).

In common with the penile portion of the canal the bulb is lined with columnar cells and presents many crypts of Morgagni and the

processes. In fact, lesions of the posterior urethral mucous membranes which do give rise to pain refer their pain into the anterior portion of the urethra

Having no submucosa for the deposition of the round cell infiltrations, which in the anterior urethra eventuate into strictures, the posterior urethra forms no postgonorrheal coarctations

Before passing to a consideration of the other parts of the urethra a few words should be said of the bladder. The general bladder wall is not susceptible to gonococcal infection unless its surface is changed by trauma or the fermentation of residual urine. The same cannot

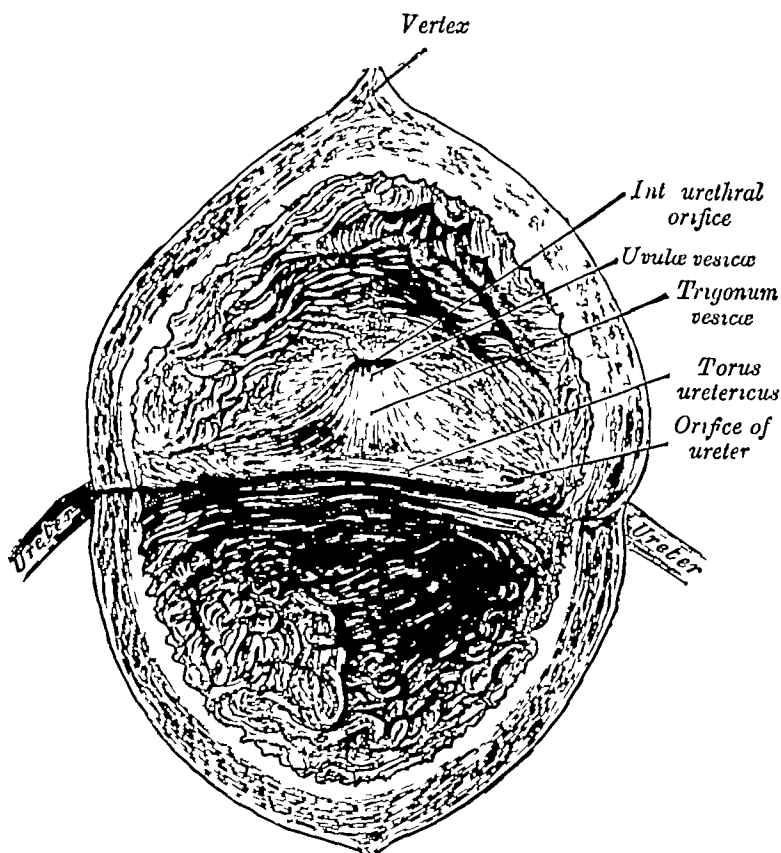


FIG 167 —The interior of the urinary bladder (Gray's Anatomy)

be said, however, of that portion of the base called the trigone. This triangular area, bounded by imaginary lines running from ureteral orifice to ureteral orifice and laterally by equally imaginary lines running from these orifices to the posterior vesical lip is in histological structure the same as the posterior urethra*. It shows like susceptibility to gonococcal infection, but its better drainage possibilities give it a more ready immunity response. It is almost invariably involved in the presence of posterior urethral gonorrhea (Fig 167)

The Membranous Urethra —This portion of the urethra, lying

* The trigone and the urethra have the same embryologic origin —(Ed)

rounded by a senu-erectile sheath the corpus spongiosum and its expanded portion the glans penis

The glands of the anterior urethra as well as the columnar cells lining the canal, carry on a secretory function which is greatly stimulated upon sexual excitement. This outpouring of mucus may also be stimulated by prolonged chemical treatment when it often is taken to be an evidence of urethral infection

The anterior urethra has a rich blood supply and a nerve mechanism that interprets superficial irritation as of a burning character. Like the posterior urethra it shows a tendency to refer its pain to the fossa navicularis, though it at times refers it to the penoscrotal angle. Its mucous membrane is more sensitive to chemical irritation than any other portion of the canal. Having a loose submucosal layer it is particularly prone upon injury to develop areas of round cell infiltration with later stricture formation

The external urinary meatus usually is the narrowest portion of the canal and as a rule instruments that will pass it easily may be passed through the entire canal in the absence of stricture

It is not rare to find the minute openings of narrow para urethral sinuses on the lips of the meatus canals that are particularly prone to be penetrated by the gonococcus and which if untreated may hold infection for long periods. On the under surface of the glans penis to each side of the frenum there are similar channels the parafranal glands which when infected by the gonococcus show a great tendency to abscess formation. If not properly treated such an infection is prolonged

Cowper's Glands.—These are two compound racemose glands lying between the two layers of the triangular ligament one to each side of the membranous urethra. Their ducts run downward forward and inward through the anterior layer of the triangular ligament pierce the corpus spongiosum and empty on the floor of the bulbar portion of the canal.

The Prostate Gland.—This gland varies considerably in size and shape in different individuals and at different ages in the same individual. It is of the compound tubular type and the acini are embedded in a thick stroma of connective and muscular tissue. Felt with the finger in the rectum it presents as a rule two lateral masses divided by a shallow mid line furrow. As has been stated it entirely surrounds the posterior urethra, into which it discharges its secretion through many small channels.

The bulk of the prostate is composed of the so-called lateral and median lobes, the anterior and posterior lobes being rarely of much size or importance. The acini and their emptying channels are lined by columnar cells. There is practically no submucosal layer. They are particularly prone to gonococcal infection by continuity from the posterior urethra and as their drainage possibilities are poor they generally hold infection for a considerable time in the absence of proper treatment.

glands of Littre, which pass deep into the loose submucosal tissues Belfield has shown that the glands of Littre in the bulbar portion run, from their openings, from behind forward, while those in the penile portion run from before backward, a fact that makes topical injection of the former practically impossible

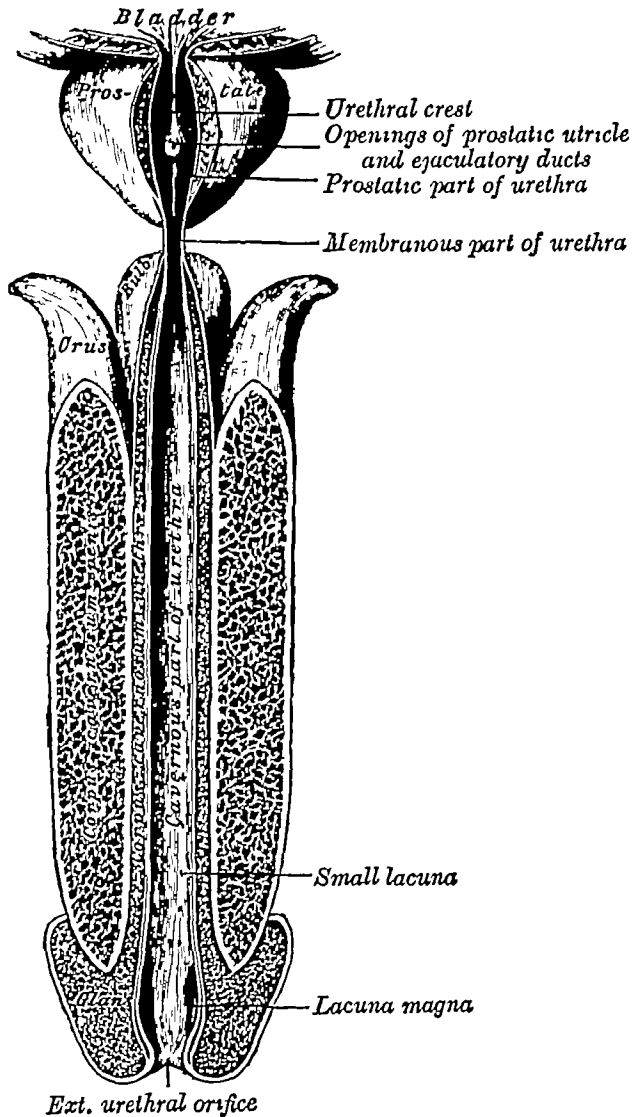


FIG 168 —The male urethra laid open on its anterior (upper) surface (Gray's Anatomy)

The penile portion of the urethra is smaller in caliber than either the posterior or bulbar portions. The fossa navicularis, the distal centimeter of the canal is fusiform, lined by squamous cells and has on its superior aspect the lacuna magna, a crypt of varying size and depth.

The entire anterior urethra runs in a cleft between the erectile bodies of the penis, the corpora cavernosa, and is completely sur-

fortunate circumstance that they are not often the seat of prolonged gonococcal infection

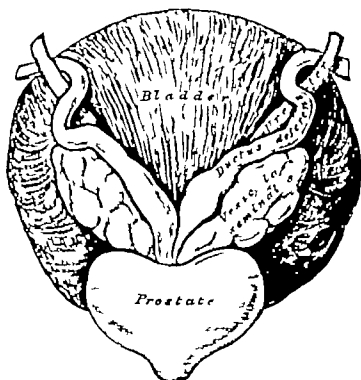


FIG. 160 —Fundus of the bladder with the vesicular seminales. (Gray's Anatomy)

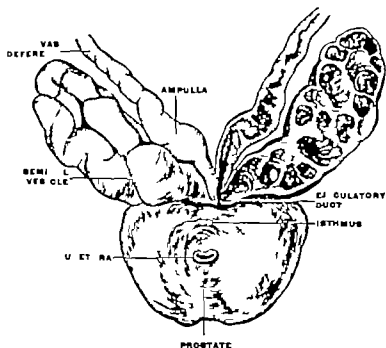


FIG. 171 —Prostate with seminal vesicles and seminal ducts, viewed from in front and above. (Spalteholz.) (Gray's Anatomy)

The gland has a rich arterial supply but its venous return is such that congestion is of common occurrence

The ejaculatory ducts pierce the posterior substance of the gland as they pass from the seminal vesicles to the urethra (Fig 169)

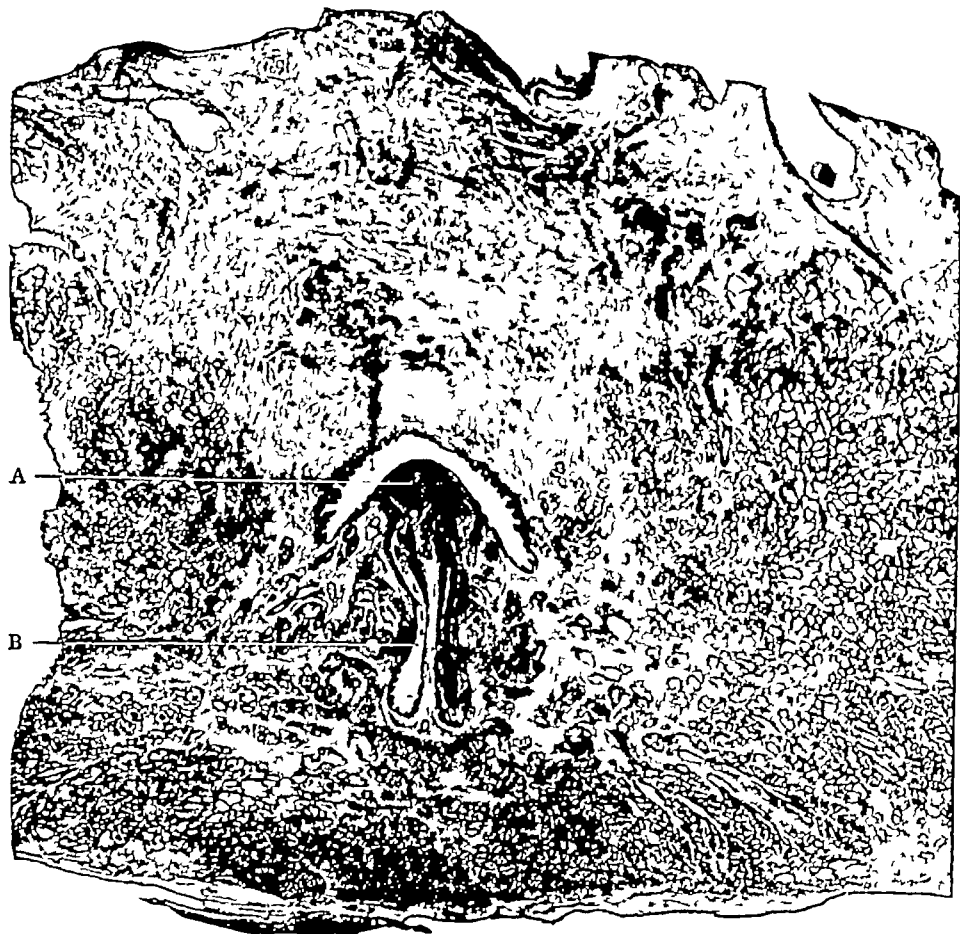


FIG 169 —Cross-section of the prostate gland, giving an excellent idea of the complexity of this structure. It is really remarkable, considering the endless number of small mucous spaces in the gland and the minute tubes through which they empty their contents, that sufficient drainage could be established by massage to cause recovery from infection. The reasons for the length of time necessary for such cures are obvious. At A we see the verumontanum with the arched space of the posterior urethra surmounting it. At B are the cross-cut ejaculatory ducts. (Courtesy of Dr Henry H Morton and W B Saunders Company)

The Seminal Vesicles.—These irregularly convoluted sacs lie below the base of the bladder, to which they are attached, just above the lateral lobes of the prostate gland. They lie in a diagonal direction with their upper extremities in contact with the distal portions of the ureters and their distal extremities converging toward, but not to, the mid-line. Here they join both the ejaculatory ducts and the ampullæ of the vasa deferentia. They are lined by tall columnar cells resting on a dense muscular coat. Their drainage possibilities are of an extremely poor order, for which reason, as will be noted later, it is a

It is to be remembered that practically all cocci reproduce by fission and that at some part of their reproductive cycle many of them have and often hold the typical morphology of the gonococcus. This is particularly so of the staphylococcus and the streptococcus and as these not only are commonly present in the male urethra but often are found in the leukocytes, they cannot possibly be distinguished by the use of a single stain. It thus is to be deplored that the practice of trusting to a methylene blue stain alone has been so widespread and still is advised by many urologists. One does not have to allow his imagination to soar very far to sense the possible sad consequences of such errors.

It safely may be said that when one encounters Gram-negative intracellular diplococci of the size and morphology of the gonococcus in smears from either the urogenital tract, the rectum or the eye, he is dealing with the gonococcus. If there are Gram-negative diplococci of smaller or larger size than the gonococcus he does well to be skeptical and to withhold diagnosis. For there are both larger and smaller cocci encountered in all of these regions which may or may not have the shape of the gonococcus. Generally these are entirely extracellular but occasionally they are not.

One should bear in mind that the question of size of the gonococcus so far as microscopic appearance is concerned varies with the eye-piece used and one who does not take this into consideration may be misled. Under a 5 λ eye-piece the gonococcus is but a minute dot while under a 10 λ it is rather a sizeable coccus. Consequently one's visual estimation of the comparative sizes of cocci had best be done by the constant use of the same power eye-piece. Even then mistakes are easily possible for while gonococci are practically uniform in size the bacteria with which they so easily may be confused often vary widely in different specimens or in the same specimen. This latter is particularly true of intracellular cocci and it often is this variation in size of the bacteria in the same cell that gives us our surest means of differentiation when these bacteria happen to show Gram negative staining characteristics. Probably never does one see intracellular staphylococci or streptococci wherein all of the cocci are Gram-negative. There probably always are Gram positive elements in the same cell. Also the Gram-negative elements in these cells vary both in size and staining intensity. So true is this that one should not be misled into calling them gonococci unless his Gram staining methods are faulty.

If he finds Gram positive and Gram-negative cocci in the same leukocyte he probably is dealing with either the staphylococcus or streptococcus and does well to go much further before making a diagnosis. Also he does well not to be too sure about sparsely located extracellular Gram negative diplococci. If it is gonorrhea intracellular gonococci usually can be found. Extracellular gonococci most commonly are found in clusters. Particularly should intracellular gonococci be demanded in studies of the female for there errors in diagnosis are more commonly made.

The point of junction of the vesicle with the vas deferens and the ejaculatory duct is of such a nature that fluids injected *via* either tubule fill the vesicle before they flow into the other channel (Figs 170 and 171)

THE GONOCOCCUS

The gonococcus, the most commonly encountered of the *Neisseriæ*, is generally described as a biscuit or coffee-bean-shaped bacterium with Gram-negative staining characteristics which, in the pus from the disease, is most commonly found within the polymorphonuclear leukocyte. Regarding some of its characteristics, as well as those bacteria commonly found in the genital tract, there is much need for a better understanding (Fig 172)

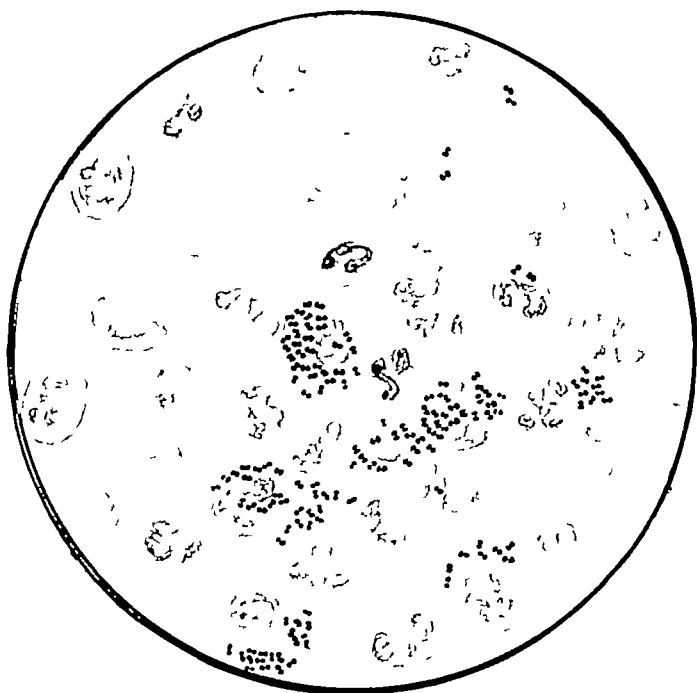


FIG 172 —Gonococci in urethral pus (Pelouze's *Gonorrhea in the Male and Female*, courtesy of W B Saunders Company)

The great quarrel is not with the Gram-negative characteristics of the gonococcus, for it is always Gram-negative, but with the fact that some other bacteria which resemble it in morphology also commonly produce Gram-negative elements when isolated in smears cannot be told from the gonococcus. Such being the case it is obvious that the diagnosis of gonorrhea is not always such a simple matter as we are prone to think, and that, without the most meticulous care, rather grave blunders are liable to occur.

Not only do some of these other bacteria produce Gram-negative elements, but they are rather commonly found within the leukocytes exhibiting the typical morphology of the gonococcus, from which they cannot possibly be differentiated without a carefully done Gram stain.

positive while others bleach and take the counterstain with varying degrees of intensity. These are not mixtures of gonococci and other cocci but are either staphylococci or streptococci. It is doubtful if the gonococcus ever is found in the leukocyte with other bacteria. At least the writer has never seen such a bacterial mixture.

Culture of the gonococcus providing an enriched moist medium of a pH between 7.3 and 7.8 is used is little if at all more difficult than culture of other bacteria nor is the gonococcus in culture the delicate organism that we have been taught to believe. It is not necessary that it be placed in the incubator at once as it will survive at ordinary room temperature for forty-eight hours or more. It will survive twenty-four hours on a block of ice or in a water-bath at 111° F. for thirty minutes or longer. Subcultures will survive a temperature of 113° F.

Pure cultures frequently can be gotten from the male between the second and fifth day of the discharge. After this they usually are contaminated with staphylococci and it is by no means a simple matter to tell which is which. By prolonged plating methods they may be isolated from such cultures.

Because of the difficulty injected by contaminating bacteria, cultural methods as proofs of cure have not come into general use. They are among the most difficult of bacteriological procedures so difficult and uncertain in fact that one should pay no great attention to negative findings. He is not very likely to have positive findings in any large percentage.

Though this be true so far as proofs of cure are concerned it must not be given universal application. One does not try to prove a patient cured by such means when he has active signs of gonorrhea; he limits culture as a so-called proof of cure to the patient who is almost or quite symptomless. In the presence of active suppuration it may be difficult to obtain pure cultures but it is in no sense impossible and circumstances may arise that give untold value to cultural methods as a means of safer identification.

What may be perfectly proper for the clinical establishment of a diagnosis of gonorrhea as a basis for treatment, may prove disconcerting to the diagnostician in a court of law. In the foregoing sentence one rather appropriately could underscore the words may prove for the looseness with which a diagnosis of gonorrhea usually is accepted in court brings a smile to the bacteriologist who has done much work upon gonococcal identification. But one should not rely too strongly upon such legal credulity for surely it cannot be universal and one would fare badly if he happened to meet the exception. He would indeed be a poor bacteriologist who could not make a better showing for the negative side than the positive in almost any case so far as courts are concerned. Some astute judges and lawyers are aware of this and tend to limit and discount negative arguments but in most courts it would be a very simple matter to cast discredit upon most diagnoses of gonorrhea.

In such diagnostic work one should use a Gram stain or its modification that gives clear-cut pictures. Some of the stains advised are not so readily prepared or so stable as are others and many of them require too long a staining period. The one that has given me the best results requires the following solutions —

- 1 Gentian violet 6 B—1 per cent aqueous solution
- 2 Iodine, 2 gm dissolved in 10 cc of normal NaOH after which 90 cc of distilled water are added
- 3 Acetone
- 4 Basic fuchsin, 0.1 per cent aqueous solution

These solutions are stable providing the basic fuchsin is kept in a jena or pyrex glass bottle or one the inside of which has been paraffined. The technique of their use is as follows —

A thin smear of the suspected material is fixed to a slide by gentle heat.

The gentian violet is placed on it, allowed to remain for about five seconds and poured off.

The smear then is covered with the iodine solution which is poured off, reapplied and allowed to remain five seconds.

The slide then is washed with acetone until no more color comes away—generally but a few seconds.

It then is washed with distilled water and the basic fuchsin is applied for five or ten seconds.

This is washed off with water and, after drying in the flame or with a blotter, it is ready for study.

There is still some confusion regarding just what the Gram stain does. It is based on the fact that if certain bacteria are stained with certain dyes and then subjected to the influence of iodine they fail to give up their dye when washed with either alcohol or acetone, whereas in others this treatment fails to make the dye alcohol- or acetone-fast. The former are Gram-positive and the latter Gram-negative. As the negative elements are bleached by this washing, it is necessary to apply a counterstain in order that they may be seen.

This method divides bacteria broadly into two groups, though there occur indifferently staining bacteria in which some elements hold the original dye and other elements do not. It is easily shown that when some of the bacteria that generally are considered Gram-positive are grown on enriched culture media they do not all develop their Gram-positive characteristics with equal speed. Thus there are Gram-negative elements among them. Particularly is this true of both the staphylococcus and streptococcus. Further, when Gram-positive cocci begin to autolyze they fail to remain alcohol- or acetone-fast and appear in smears stained a pale red. Sometimes the urethral secretions are such good culture media for these bacteria they they produce many Gram-negative elements which often cannot be differentiated from the gonococcus in smears when found as isolated diplococci. Again, it is not altogether uncommon to encounter cocci of many shapes and sizes in the same leukocyte, some of which are Gram-

Some patients who should be positive never are and some who long since have been cured remain positive.

It is possible that several positive tests by a good serologist who is repeatedly making such tests is fairly reliable evidence that the patient has or recently has had an attack of gonorrhea. On the other hand a negative test probably means about the same as some negative Wassermann tests nothing.

While the test is seldom really necessary for the diagnosis of frank gonorrhea in either sex it has a definite value in obscure cases of long duration. Particularly has it a value in the medico-legal aspects of this disease for with its data one makes a far better showing in a court of law. Assuredly properly carried out tests giving repeated positive findings mean gonorrhea. Taken with the history and other possible findings it is legally conclusive. Its possible variations detract from its value as a reliable proof of cure certainly within a few months of the disappearance of clinical symptoms.

Mode of Transmission.—While the accidental transmission of gonorrhea is a possibility one is hardly likely to see such a case in the male in a very long life time. As the writer has stated elsewhere he has never encountered such a case though he has seen many individuals who at first strenuously denied extramarital exposure. Such individuals almost invariably can be made to tell the truth at a later visit if the physician is in a position to boast of some imaginary sexual derelictions of his own. They unburden themselves only when they feel that their listener is as bad as or worse than themselves. Those who do not remove the mystery usually have been infected by their wives. Some few have been indulging in that increasingly common form of sexual indiscretion oral coitus.

In female infants the disease commonly is transferred by means of contaminated linens or the unclean hands of the nurse. In adult females this probably is almost never the case the disease being predominantly the result of sexual contact with an infected individual.

Incubation Period.—The average period of incubation is from three to five days. Upon extremely rare occasions the symptoms may appear slightly before the end of seventy two hours. This probably occurs only in individuals who have consumed much alcohol or have had much sexual intercourse in the meantime.

Incubation periods longer than five days are by no means rare. In some of these the prolonged incubation period is more apparent than real. For it is possible for gonorrhea to be so mild and devoid of symptoms that the patient is not aware of its presence until he has stirred it into greater activity by either alcohol or coitus. In fact, most of the seemingly long incubation periods are thus terminated.

Because of the possibility of such latent infections there is value in withholding the answer in exposed males who present no symptoms until they have remained symptom-free and microscopically negative after the consumption of some alcohol. It is safe to say that the appear

Such being the case, he who cares for patients with gonorrhea will do well to consider them from their possible social angles, certainly so far as their problems may end in a court of law. If such an eventuality seems even remotely possible the questions of both cultural and serological data should be considered. Two things make such cases important, the vindictiveness of the parties concerned, and their wealth. The physician does well to fortify his diagnosis with data to appease a court of law whenever either or both of these are even remotely in the offing. He should be able to add to the weight of his reputation as a diagnostician the legally satisfying story of both culture and serological study when he is asked that cold, hard question, "How do you know it was the gonococcus?" Lacking these, he is at the mercy of any cross-examiner who pauses to spend a few moments with any text-book upon bacteriology. What seems good "sausage" for the medical profession may be "meat" for the legal profession.

In order to obtain material for cultural purposes from patients who have no urethral discharge the anterior urethra should be thoroughly cleansed with an efficient germicide, 1 to 10,000 bichloride of mercury, 1 to 2000 acriflavine or 1 to 100 carbolic solution some of which should be held in the urethra for some minutes and then allowed to drain out. After a few minutes the glans penis should be washed with soap and water followed by alcohol, and the prostate gland and seminal vesicles should be stripped by the finger in the rectum. If any secretion can be made to appear at the urethral meatus, it should be collected in a sterile test-tube or beaker. If this is not obtained the patient should be instructed to pass some urine into two large sterile test-tubes. This urine should be sedimented in the centrifuge and the sediment plated out on culture medium.

The Complement-fixation Test.—For a number of reasons the complement-fixation test for gonorrhea has not been largely used in America. Some workers, particularly McNeil, have been notable exceptions. So seldom is the test done that in many laboratories it is none too reliable when it is done. If carefully carried out with a good antigen there is no doubt that the test is of much value in some obscure cases, particularly in the female where microscopic diagnosis is not always so easily made as it generally is in the male. It perhaps finds its greatest value in metastatic gonorrhea in those patients presenting no discernible local evidences of infection.

The test is practically never positive in anterior gonorrhea in the male nor in acute vulvo-vaginitis in the female. It is seldom positive in any type of case during the first month of the disease. Positives begin to appear after this interval in males with posterior urethral infection with its concomitant prostatitis and in the female. Having become positive, it usually remains so until six or eight weeks, or longer, after cure has taken place. While the use of vaccines may change a weakly positive to a strongly positive test, they seem not to make any change in the test if the reaction previously was negative.

showing every evidence of inflammation contained few gonococci except in the neighborhood of the crypts and glands.

With this description one can find no fault. It has to do with actual observations upon early gonorrheal urethritis. The fault is with what has been added to it as the result of observations by others during the various stages of gonorrhea which observations have been interpreted as the usual pathology of the disease. For instance we have been led to believe that large numbers of surface cells are shed in the first two days of gonorrhea and far larger numbers after the greatest severity of the inflammation has subsided. Either this is wrong or these desquamated cells are disintegrated before they can reach the external meatus, and no one really believes this. A microscopic study of the urethral discharges from gently treated patients shows but a few epithelial cells in any stage of the disease. During the active stages these cells are present but are so outnumbered by leukocytes as to appear to be very scarce. The appearance of large numbers of epithelial cells in the discharge is safe evidence that the patient either has an old stricture or the particular chemical substance being used is far too irritating for the given mucous membrane. Under these latter conditions desquamation is due to an effort on the part of the mucous membrane to protect itself from chemical trauma by building up of a protective layer. When a mucous membrane starts this process it always overdoes it and desquamation of excess cells is the answer.

Regarding the question of edema it is safe to say that to a slight degree it is always present in the early stages of infection. Usually marked edema means chemical instrumental or physiological trauma. It generally is observed in those patients who have had much alcohol or have indulged freely in sexual intercourse during the incubation period or the first few days of the disease. Such being the case we safely may discount marked edema as a common manifestation of gonorrhea alone.

Turning to the question of marked round-cell infiltration we also may discount it largely as a prominent part of the pathological picture in untraumatized gonorrhea. One only need cite the present rarity of urethral stricture as compared with the incidence a decade or two ago when most treatments for the disease were of an energetic sort. For marked round-cell infiltration leads to the formation of fibrous tissue which in its contraction forms an urethral coarctation. In other words stricture is rarely a result of gonorrhea it is a result of urethral trauma in the presence of gonorrhea.

As we have become a softer kinder race we largely have deleted trauma from our treatments and as a result, marked round-cell infiltrations have become the rarity rather than the rule. Where they are found the question of trauma almost invariably presents itself in the history.

In China postgonorrheal stricture almost never occurs. When a poor Oriental acquires the infection he lives it down he gets no local

ance of gonorrhea within forty-eight hours of a given sexual exposure, is not from that exposure. It is either a flare-up of an older infection or the result of an exposure shortly antedating the one in question.

THE PATHOLOGY OF GONORRHEA.

Being of the nature of both a surface and subsurface infection, so far as the urogenital mucous membrane is concerned, a consideration of the pathology of gonorrhea largely can be confined to the various changes brought about in these limited structures. Much of what formerly was described as the microscopic pathology of the disease was not due solely to gonorrhea itself. We have learned that the marked round-cell infiltrations described were more often the effects of traumatic treatment. There consequently exists a need for a division between the true mucous membrane pathology that really is due to the infection and that due to the infection plus trauma. This difference is not alone confined to the later stages of gonorrhea but is added to the picture at all stages wherein the mucous membrane is subjected to direct instrumental or chemical trauma.

The added pathology from such procedures, together with that due to hygienic faults of the patient himself, gives a magnification of what the gonococcus does to these structures. It has led to misinterpretation of urethral discharges microscopically and a rather general confusion regarding the true tissue changes. Particularly has this been true of the questions of epithelial exfoliation, mucosal edema and deeper tissue infiltrations. While most of these, to a limited extent, are present in every mucous membrane infected by the gonococcus and to a severe extent in some few, their marked occurrence in most cases is to be attributed to treatment or patient conduct.

Before going too deeply into these phases of the question, however, it might be well to quote Keyes' summation of the findings of Finger, Ghom, and Schlagenhauser upon artificially inoculated gonorrhea in 1894 as cited by Barringer in the first edition of this work.

"Thirty-eight hours after inoculation the gonococci had only just begun to effect an entrance between the epithelial cells. The lacunæ of Morgagni were crowded with cocci, diapedesis had begun and intracellular gonococci were found among the few leukocytes on the surface of the epithelium. At the end of three days the inflammatory process was well under way. The surface of the mucous membrane was covered with pus, its epithelium infiltrated by bacteria from one side and by leukocytes from the other. The inflammation showed four striking characteristics, viz (1) The pavement-epithelium of the fossa navicularis, although swollen with leukocytes, resisted the invasion of the gonococci almost absolutely, (2) the cylindrical epithelium of the penile urethra was generally invaded, (3) this invasion was most marked about the crypts and glands, which were packed with pus and gonococci, (4) the subepithelial connective tissue, though

when it attacks urogenital mucous membranes. Being a disease due to tissue penetration by the infecting organism few things are more important to an understanding of it than are those of the varying behaviors of certain portions of the urogenital tract toward the gonococcus. Though these controlling factors rest largely in the type of cells covering a given surface they to a smaller degree are dependent upon the type of attachment that the mucous surface has to its subjacent structures. Added to these are the influences that rest in the varying degrees of physiological activity belonging to these mucous membranes.

While these things lend themselves to lengthy discussion time and space can be conserved by stating the more important of them in a brief perhaps dogmatic way as follows

1 Squamous surfaces are practically immune to gonococcal infection, though they may be irritated by the surface action of the products of such infection in adjacent surfaces.

2. Columnar surfaces that show no cuticular layer, and those in the urogenital system do not are easily penetrated by the gonococcus and exhibit a less ready immunity response than any other type membrane

3 Transitional surfaces show varying degrees of susceptibility which seem to rest more in how the surface is attached to the subjacent muscular structures than in the cells themselves.

Having stated our three most important rules it is perhaps well to discuss them briefly before going on to others. Regarding squamous surfaces it is obvious that we may almost disregard them as true seats of disease and consider them solely as the victims of the discharges from other membranes. This at once places in a position of secondary importance a limited area in the male urogenital tract, the fossa navicularis and the comparatively more vast squamous areas in the adult female tract. This does not apply so fully to the female before puberty for her vagina and introitus have not yet become lined by squamous cells. They still exhibit the characteristics of transitional elements.

Passing on to our most susceptible type of tissue that covered by columnar or cuboidal cells, we find that the gonococcus has no difficulty whatever in penetrating it and reaching its deeper layers. We find here our most active cellular physiology and an immunity response seldom rapid and easily put in abeyance by anything that stimulates this cellular physiology viz the hyperphysiology of menstruation sexual excitement and alcohol if this latter influence is really due to increased physiology

We further find that the immunity reactions of such surfaces in a great measure are dependent upon the possibilities for drainage, which we shall further discuss under the heading of The Influences of Anatomical Structure on Gonococcal Infection.

Columnar surfaces, being inherently tardy in immunity response become for us our most important consideration in this regard for

treatment for it. Consequently he gets no marked round-cell infiltrations. He does have a polymorphonuclear leukocytic mucosal infiltration in which a far smaller number of round cells are found.

There is a diapedesis of polymorphonuclear leukocytes, some mononuclear ones and some round cells. The leukocytes exude from the surface in varying numbers according to the degree of inflammatory reaction present and some of the mononuclear ones are mistaken for epithelial cells in the smears of pus. The polymorphonuclear leukocytes show very little power of phagocytosis of gonococci in the deeper tissues, far more in the epithelial interspaces and usually a marked degree in the urethral lumen. So marked is this latter as a rule that it is common to see all of the gonococci present within the leukocyte. At times, for brief periods, even this phagocytic action is limited and all of the gonococci are extracellular.

As the infection subsides the outpouring of purulent products decreases and gradually ceases, so that long before the gonococcus has disappeared from the tissues the visible evidence of its presence no longer is to be found unless caused to reappear by artificially applied influences.

Just how correct we are in our common descriptions of the reparative stages of gonorrhea is a question. In them it is probable that we have been guilty of the same magnification of the phenomena at play as appears elsewhere. We have been wont to describe the building up of layer after layer of epithelial cells with a tendency of the more superficial layers to become squamous in character and even to go on to keratinization. There is more reason to believe that this cellular transformation is an effort at protection against our treatments rather than a necessary tissue change engendered by gonorrhea alone.

It thus will be seen that there exists a real need for research in this regard before we are in a position to separate those changes due to gonococcal infection alone from those due to gonorrhea subjected to many other factors.

We, therefore, are in a position to say that the pathology of gonorrhea itself differs little in different tissues. The differences that do occur are largely those due to the differences in histological structure and anatomical conformation, and for this reason it is in no sense necessary to describe them in the different structures, particularly in view of the fact that the influences of these things upon the clinical course are discussed in other sections of the present article.

THE INFLUENCES OF HISTOLOGICAL STRUCTURE ON GONORRHEAL INFECTIONS

The importance of the influences of histological structure upon gonococcal infections has not been recognized generally. Perhaps nowhere in the human body is it possible to lay down more fixed rules of infection incidence and behavior than is the case with this disease.

way in which they are attached to their subjacent tissues for singularly enough, transitional surfaces that are closely bound to the subjacent tissues are highly susceptible the posterior urethra and trigone. Those underlain by tissue rich in elastic fibers the bladder ureters and kidney pelves, are practically immune unless their surface cells are injured by trauma or urinary fermentation.

In other words transitional surfaces covering structures that undergo marked dilatation as part of their function show an inherent immunity to gonococcal infection in contradistinction to those covering surfaces undergoing little or no stretching. We may conclude our discussion of this type of tissue by saying that, when it does become infected it shows such a ready immunity response that it may be largely disregarded in our consideration of prolonged infections.

Viewed in its entirety we see a tract lined by mucous membranes that together with other factors do much to control the sites and duration of gonococcal infections. It is patent that a knowledge of the histological investiture the influences of stimulated cellular physiology as well as the matter of anatomical structure are essential to a well rounded knowledge of gonococcal infections of the tract. Without this few diseases are more confusing and perhaps none is more liable to the application of much futile treatment that in itself increases the gravity of the disease to the patient as well as enhancing it as a menace to humankind.

The Influences of Anatomical Structure—Holding a position in our understanding of gonorrhea that is almost if not quite as important as that part played by histological arrangement, stands the question of anatomical conformation. Unless we can visualize and understand the factors it presents we again are far from sensing the complete disease picture.

Not only is this of importance from the standpoint of disease spread but it is perhaps of greater importance as a determining factor in curability for we here are dealing with a pus-forming disease in which the matter of drainage is paramount. We must know what are the effects of good drainage poor drainage intermittent drainage or no drainage upon the course of the infection. In such knowledge rests the key to the understanding of any infection as well as a sensible interpretation of the disease vagaries so often encountered.

Here again the question lends itself rather well to the laying down of some pretty reliable near-rules. First let us enumerate those that have to do with disease spread.

- 1 There is much evidence that gonorrhea is a surface and subsurface disease and unless it is carried from surface to surface by some form of treatment or trauma it progresses by continuity.

- 2 So far as the urogenital tract is concerned there is little in the clinical or pathological picture to suggest that lymphogenous or hematogenous transference play any part whatever. (We are not speaking here of metastatic gonococcal lesions in other parts of the body.)

- 3 The contraction of the cut-off muscle offers a definite but by no

it is to these surfaces we must look for the causes of persisting infection. So true is this that we safely may disregard the others under such circumstances, or consider their inflammation as being kept active by continued infection in some associated columnar-lined structure. Thus the battle becomes one of attack on columnar surfaces, in which attack both squamous and transitional surfaces may almost be left to take care of themselves.

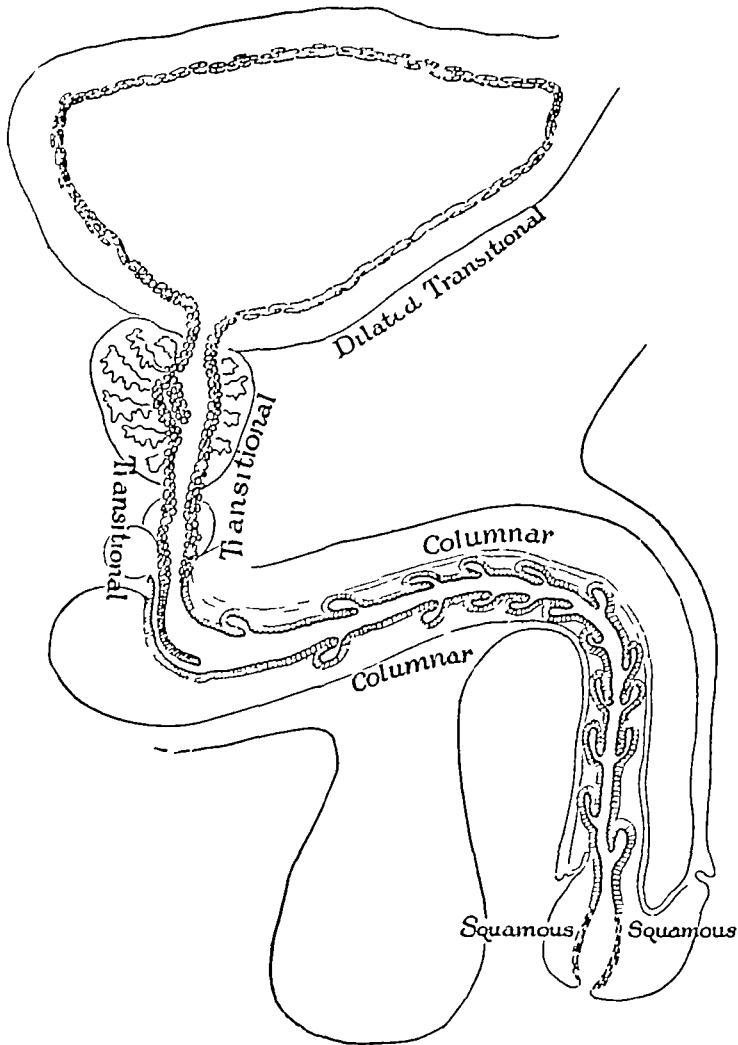


FIG 173 —Diagram to show the usual locations of the various types of cells lining the lower urinary tract (Pelouze, *Gonorrhea in the Male and Female*, courtesy of W B Saunders Company)

Turning to transitional-celled surfaces we find that we must make qualifications when we talk of their susceptibility to gonococcal infection. Of course no one knows what the real reasons are, but certain of these surfaces show a susceptibility equal to that of columnar surfaces, while others are as resistant as are squamous surfaces. Until research tells us why, we shall have to let the question rest with the

they rupture or are incised they are prone to leave intermittently draining channels.)

It thus can be seen that there are in the questions of structure things that in the absence of what we might call physiological insult are our greatest controlling factors and that they must be understood if treatment is to be of greatest value. It is largely through lack of this knowledge that gonorrhea has appeared to be such a confusing disease.

Virulence of Infection.—It has been taught that gonococcal infections characterized by the most severe symptoms are due to infection by a particularly virulent strain of gonococci. In the writer's mind there is the conviction that gonococci do not differ greatly in virulence. He finds little in the clinical picture of the disease to suggest that such is the case and much to indicate that the difference rests in the individual instead of the gonococcus. As varies the culture medium so varies the luxuriance of gonococcal growth and by the same token the amount of endotoxin liberated by the gonococcal disintegration. Further as varies the amount of liberated toxin so vary the local symptoms. An abundant study of those individuals presenting the symptoms, such as profuse discharge, marked mental edema, lymphangitis and preputial edema that we classify as due to bacterial virulence usually negatives the thought of such a causation. Almost invariably these signs of severity are found in those individuals who either have consumed alcohol, indulged in some sort of sexual relief or injected strong chemicals into the canal during the period of incubation or during the first few days of the disease.

The finding of both mild and severe disease manifestations in different individuals acquiring the disease from the same source lends little strength to the theory of differing degrees of bacterial virulence. Nor does the observation that blonds more commonly have severe symptoms add much to the virulence concept.

Immunity Aspects.—One cannot study a microscopic slide of a gonorrheal mucous membrane and visualize the points to which the gonococcus penetrates into the tissue and be very enthusiastic over the thought that patients really get well because of the bactericidal value of the medicaments that we apply to the tissues. The entire picture shows that, as is the case in other tissue infections, recovery comes by virtue of the patient's ability to generate changes in the infected tissue that make it an unpleasant place for the gonococcus to reside. Just what these changes are has not been determined but they safely may be placed in the category of those that we include under the title of immunity responses.

Years of observation of the clinical manifestations of these immunity responses have placed us in a position where we can place much reliance upon many of them. Some we even may call rules.

1. There is no true immunity against gonorrhea in the columnar lined portions of the urogenital canal.

means absolute barrier to the spread of infection to the posterior urethra

4 There is nothing to protect either the urethral follicles from infection in anterior urethral infection, or the prostatic follicles in posterior infection

5 There is nothing to protect the trigone in posterior infection, since the weak vesical outlet sphincter is no infective barrier

6 Infection seldom passes for long distances through narrow mucous channels by continuity of surface, though they be lined by the most susceptible type of cells. Hence the common protection of Cowper's glands, the seminal vesicles and epididymes (See under Cowperitis, Seminal Vesiculitis and Epididymitis)

7 The bladder wall and upper urinary tract almost invariably escape infection, probably as the result of histological structure

8 Gonococcal infections rarely pass for long distances over inhospitable mucous membranes by continuity of surface. They usually are mechanically transported there

Of equal interest are the influences of anatomical structure upon the curability of gonorrhea, and, as these are almost solely the result of drainage factors, we might cite again some near-rules in this regard

1 A surface that drains well overcomes infection well, providing the patient is able to develop the usual immunity responses and avoids those things known to retard cure

2 Freely draining surfaces hold their sensitiveness to gonococcal toxins for long periods of time and continue to discharge as long as these toxins escape from glandular infections

3 A tubular gland that drains well recovers of its own accord

4 A tubular gland that drains intermittently remains infected for long periods of time and usually causes an increase of urethral symptoms in the male whenever it empties itself

5 A tubular gland that does not drain at all brings about its own sterilization. It becomes fibrotic and ceases to be a part of the gonorrheal picture

6 This brings us to a rather safe rule to the effect that any surface in constant contact with the same gonococcal pus for a few weeks brings about a lytic sterilization of its contents as well as of the gonococci in its immediate walls (Epididymes, urethral follicles, Fallopian tubes and usually the seminal vesicles when they become infected)

7 Occasionally closed tubular glands undergo abscess formation usually as the result of a mixed infection or trauma

8 Racemose glands usually become abscessed when infected (Cowper's and Bartholin's)

9 Some tubular glands, notably the urethral follicles, are predisposed to good drainage

10 Other tubular glands (para-urethral sinuses, Skene's glands, the endocervical glands and the para-frenal glands) almost always exhibit intermittent drainage and consequent chronicity of infection (The para-frenal glands usually undergo abscess formation, but when

they rupture or are incised they are prone to leave intermittently draining channels.)

It thus can be seen that there are in the questions of structure things that in the absence of what we might call physiological insult, are our greatest controlling factors and that they must be understood if treatment is to be of greatest value. It is largely through lack of this knowledge that gonorrhea has appeared to be such a confusing disease.

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1 There is no true immunity against gonorrhea in the columnar lined portions of the urogenital canal.

2 There is developed a transient immunity to the particular type of gonococci causing a given infection

3 This immunity is not active against gonococci from another source, with which a patient may be infected though he already has gonorrhea

4 The immunity against a given type apparently dies out in from three to eighteen months, so that the patient again may become infected by it

5 After repeated reinfection by the same "strain" of gonococci the patient may become a "carrier" showing no symptoms of the disease himself but able to transfer it to another

6 A "carrier" may transmit his gonococci to another than the one with whom he has consorted for years, and their activity may thus be changed so that they again become able to produce in him an active infection

7 The first sign that Nature gives that the infection is being overcome is a reduction in the symptoms, particularly in the amount of purulent discharge

8 Under ideal circumstances these immunity responses are uniformly progressive, as evidenced by a gradual improvement rather than an irregularity in course

9 Progress can be interrupted by alcohol, sexual excitement, large doses of gonococcal vaccines, menstruation and, at times, excessive physical exertion

10 Articles of diet, other than alcohol, have no influence

11 Irregularity of progress that is not due to treatment or the things mentioned under "9" is the results of the emptying onto the free mucosa from some accessory structure of some pus rich in gonotoxin. Such recrudescences usually subside within forty-eight hours

12 In most males, who do not introduce the immunity-inhibiting factors above mentioned, spontaneous cure would take place

13 In the menstruating female the disease colonizes in the cervical and other glands and remains for long periods of time unless these structures are destroyed. Chronicity is the rule and spontaneous cure either rare or long delayed

14 After the menopause the disease becomes self-limited, as in the male

15 Before puberty in the female the immunity responses seem to be weak and prolonged infection is the rule. Toward puberty it usually clears up if it has persisted that long

The Causes of the Symptoms of Gonorrhea.—The symptoms of gonorrhea are not due to the mere presence of live gonococci, but to the toxins liberated upon the death and disintegration of gonococci. Hence they are severest during the most active stages of gonococcal proliferation and death, and diminish as the numbers of gonococci decrease. They are true mucosa toxin responses and can be produced even by the injection of gonotoxin into the urethral canal. An understanding of these responses helps greatly in our interpretation of the

clinical course of the disease as well as the clinical changes resulting from the various influences that change the regular course of a given case. Here again we well may resort to some near rules.

1 If gonococcal vaccine is injected into any urethra infected or otherwise there will appear within twelve hours a profuse purulent discharge which will disappear in the absence of treatment within forty-eight hours.

2 The same thing occurs during the course of gonorrhea whenever retained gonococcal pus is emptied onto free mucosal surfaces. As a rule such a reaction subsides within forty-eight hours.

3 The free mucosa retains this sensitiveness to the patient's own gonococcal toxins for years and only loses it as the result of repeated infections from the same "strain" (The carrier stage.)

4 The sensitiveness to the toxins of other strains is never lost.

5 Many of the clinical entities which we have regarded as reinfections are in reality toxin responses of existing infections occasioned by physiological or traumatic insult or by the release of pus from retention pockets.

6 It is not often possible to superinfect a patient with his own "strain" though he repeatedly may be reinfected with it.

7 He always can be superinfected by a heterologous "strain."

FOLLOWING THE COURSE OF GONORRHEA

One who takes the time to understand thoroughly the significance of the appearance of the urine when passed into two glasses will have little trouble in following intelligently the clinical course of gonorrhea in the male. For in the male it safely may be said that the amount of pus poured out into the urethra and bladder is a reliable index of the activity of the infection. It should be remembered however that the urine is a safe index only to the point of latency of infection and that after this point has been reached infection may continue for a long time though the patient passes a crystal clear urine in both glasses. It is the habit of the gonococcus to colonize in the smaller glandular structures where it may produce very little pus far from enough to empty constantly into the urethra and it is really urethral washings that we are looking at in the later stages of the disease.

Referring to our anatomy we see that the anterior urethra is divided from the posterior urethra by the tonic contraction of the cut-off muscle and it is obvious that any pus in this portion of the tract will be washed out by the first urine voided and will all be in the first glass provided the patient passes enough into that glass entirely to cleanse that portion of the canal. Furthermore providing the patient had no other infection that would cloud his bladder urine the second glass of urine will be clear.

When the posterior urethra becomes infected we find a far more complicated state of affairs. Here we have a short canal whose proximal extremity is closed by the vesical outlet sphincter. Because of this

mechanism, if any quantity of pus finds its way into the posterior urethra it will seep back into the bladder and contaminate its urine. In the active stages of posterior urethritis this is just what takes place and, during the first few days, it is added to by the trigonal infection.

Urine voided by a patient at this time will show pus in the first glass and also the second glass. Thus there will be no doubt about the existence of posterior infection.

After a varying length of time the trigonal infection subsides to a point where it produces no pus, and contamination of the second glass of urine is dependent solely upon the seeping into the bladder of pus from the posterior urethra. This will require that more pus accumulate between urinations than the posterior urethral can accommodate. As the posterior infection subsides there ceases to be that much pus, the bladder urine ceases to become contaminated, and all of the pus present in both the anterior and posterior portions of the canal is washed into the first glass of urine, while the second glass is crystal clear. In other words, the urinary picture in a subsiding posterior infection is the same as that seen when only the anterior urethra is infected.

Following is the purport of the various urinary pictures and their causes taken from the writer's book on Gonorrhea *

<i>First glass</i>	<i>Second glass</i>	
Cloudy	Clear	(a) Acute anterior urethritis (b) Acute anterior urethritis with mild or subsiding posterior involvement
Hazy	Clear	(a) Mild acute or subacute anterior urethritis (b) Mild acute or subacute anterior urethritis with mild posterior involvement
Shreds	Clear	(a) Subsiding anterior urethritis (b) Subsiding anteroposterior urethritis (c) Chronic urethritis generally as the result of deeper foci of infection in the prostate or other associated small channels
Cloudy	Cloudy	(a) Acute anteroposterior urethritis (b) Cystitis or upper-tract suppuration
Cloudy	Hazy	Subacute or mild anteroposterior urethritis
Hazy	Hazy	(a) Subacute or mild anteroposterior urethritis (b) Bacteriuria
Clear	Cloudy	(a) Seminal fluid (b) Contents of pus pocket (c) Sedimented mucus, or phosphates from a poorly emptying bladder (d) Slight terminal bleeding

For purposes of record charts may be made of the urinary trends during the course of gonorrhea (Fig 174). A study of these urinary charts gives a good visualization of how gonorrhea progresses and declines. Particularly do they show that from the moment the urine

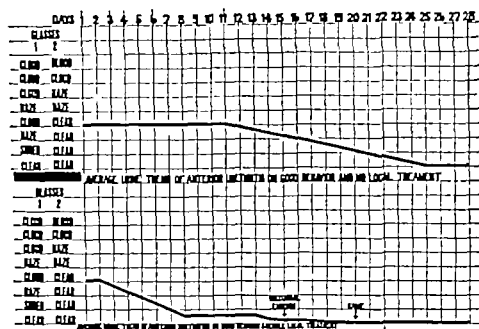


FIG. 174.—Graphic chart of the urine trend in well-behaved patients without and with gentle local treatment (Pelouze Gonorrhea in the Male and Female courtesy of W. B. Saunders Company.)

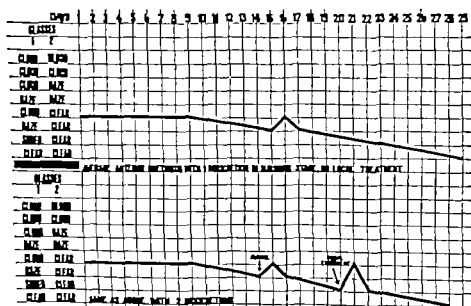


FIG. 175.—Graphic chart of the urine trend of anterior gonorrheal urethritis as influenced by alcohol and sexual excitement. (Pelouze Gonorrhea in the Male and Female courtesy of W. B. Saunders Company.)

starts to clear the process of recovery is a steady one and that abrupt changes are to be attributed to things done by either the patient or his physician (Fig 175) Rarely are they disease vagaries *per se* (Fig 176)

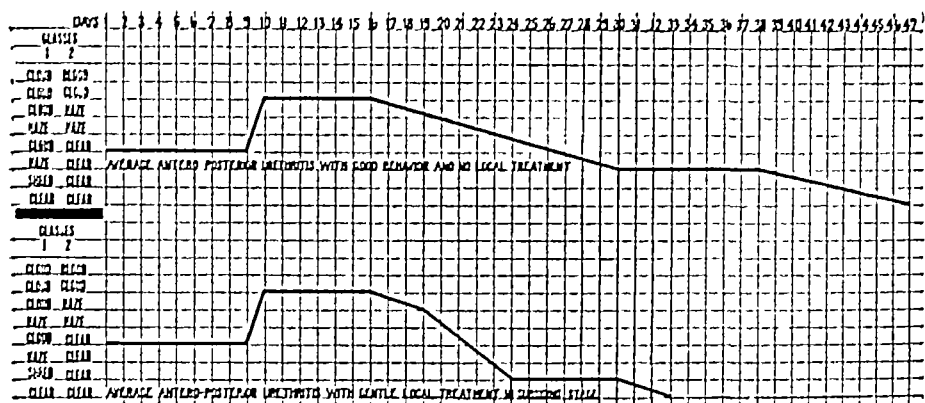


FIG. 176—Graphic chart of the urine trend in anteroposterior gonorrheal urethritis (Pclouze, *Gonorrhea in the Male and Female*, courtesy of W. B. Saunders Company)

Prophylaxis.—It has been well shown that there is definite preventive value in the use of chemical prophylaxis immediately after sexual exposure. The value of such preventive measures diminishes greatly as the time increases between the exposure and their use. Within the first half hour their value, if carefully used, approximates 90 per cent, but they should be tried even as late as twenty-four hours. If used after the gonococcus has penetrated the urethral surface they are useless.

Among the most common drugs used for such prophylaxis are 1 or 2 per cent protargol, 10 per cent, argyrol or silver nuclemate, 1 to 2000 neutral acriflavine. The former has the value of being almost stainless. The strength of solutions used is greater than those used in routine treatment, in fact of sufficient strength to engender a purulent response in many patients. For this reason patients should be warned against anxiety over the appearance of this discharge shortly after such prophylactic treatment.

As soon after exposure as possible the external genitalia should be washed thoroughly with a good soap lather and carefully rinsed. The patient should pass urine in order to flush out his anterior urethra, after which 5 or 6 cc. of the chosen chemical should be injected into the anterior urethra and held there for at least five minutes. After this is allowed to escape the entire external genitalia should be anointed with a 30 per cent calomel ointment as a preventive against syphilis. This should be allowed to remain for several hours.

The careful use of a good condom is perhaps more reliable as a preventive provided it does not break. The number of infections occurring in those who use condoms shows that they are far from

absolute protection and that it would not be altogether wasted effort to add chemical prophylaxis as an extra precaution.

The writer's observations have not given him great confidence in the prophylactic substances in an oily base.

Obviously the best form of disease prevention is continence—a thing that seems less and less to engage the fancy of youth and early adolescence. Unquestionably one of the greatest calls of the day is public education regarding the dangers of promiscuous sex contacts, for it is largely through ignorance of these dangers that many infections occur. However much we may deplore some of the present trends it is obvious that those who will not refrain from these pursuits should be taught to take care of themselves as well as such things can be done. As physicians we are interested in disease and its prevention and to oppose prophylaxis is to oppose a method of disease prevention that has proved its value.

Symptoms of Acute Anterior Gonorrhea.—There is much to be gained by overcoming the general impression that gonorrhea is always associated with marked pain on urination and profuse discharge. For many mild infections are viewed lightly because they are not early accompanied by these symptoms. Also many mild attacks are mistaken for non-specific urethritis for the same reason.

In well behaved males an attack of gonorrhea usually is ushered in by a sensation of itching at the urinary meatus and perhaps a slight burning sensation on urination. Shortly thereafter there appears a purulent discharge from the urethra which for a few days increases in quantity. In poorly behaved individuals the burning is more intense and the discharge generally more profuse.

If the symptoms are severe there is much involvement of the corpus spongiosum which limits its distensibility causing pain on erection. Seldom does this limitation cause downward curvature of the penis (chordee) unless there has been some urethral or penile trauma. There are wide variations in the severity of the symptoms exhibited by different individuals as would be expected but the severer ones are the rarity and not the rule.

Within a few days the urethral discharge reaches its quantity peak, where it remains for a varying number of days. Unless interfered with by some of those things known to retard recovery the discharge gradually diminishes in quantity until the voided urine shows but a faint soiling with pus. Later the only evidences of discharge are the presence of some shreds in the first glass of urine. These gradually disappear the urine becomes clear and though there still may be infection there remains no objective evidence of it.

If the infection passes into the posterior urethra the symptoms do not abate the discharge continues or increases in quantity and there are added the symptoms of posterior urethritis.

Such is the course of anterior gonorrhea influenced by treatment and without treatment it generally extends into the posterior urethra. Under gentle treatment and good patient cooperation posterior urethral

infection commonly can be prevented, the anterior infection can be greatly shortened and its manifestations greatly reduced

Even under the most careful treatment gonorrhea in the non-cooperative patient runs a prolonged erratic course in which posterior infection almost invariably takes place and other complications are common

Symptoms of Posterior Gonorrhea.—A more proper designation would be anteroposterior gonorrhea for the anterior urethra not only is the source from which the posterior obtains its infection but it continues to be infected as long as the gonococcus remains in the posterior structures

While the onset of posterior urethral infection usually is heralded by those classical symptoms of cystitis, frequency of urination and pyuria, it is to be remembered that in a good number of patients posterior involvement causes no subjective symptoms. Particularly is this true of cooperative patients who have been given gentle anterior treatment. It is by no means uncommon to see patients whose only sign of posterior infection is the presence of pus in the second glass of voided urine

With the development of posterior infection there usually is an increase in anterior urethral discharge, burning along the urethra may occur where it was not previously present. The vesical discomfort resulting from the extension of infection to the trigone may be mild or severe. Rarely is it mild in the patient with neurotic tendencies. This trigonal discomfort continues for a varying number of days and gradually ceases. During its presence there is both diurnal and nocturnal frequency of urination and at times vesical tenesmus at the end of urination. If the vesical outlet congestion is great there may be seen a few drops of blood at the end of urination, terminal hematuria.

As the posterior urethral discomfort subsides there usually is a slight clearing of the second glass of voided urine. This becomes progressively less cloudy and finally entirely clear, though the first glass of urine still contains pus.

There is always an associated prostatic infection which in most patients produces no subjective symptoms. Occasionally the gland swells to such enormous proportions as to produce symptoms of rectal pressure. At times its drainage is so interfered with that there occurs a marked temperature rise with a high leukocyte count. Most of these enormously swollen glands subside spontaneously without gross abscess formation. One should not be stampeded into operating upon them by a few days of fever and rectal discomfort, nor a high leukocyte count. Strangely enough the leukocytosis may persist for some weeks after the prostate has assumed its normal size. Rarely such a swollen gland will make urination impossible and catheterization becomes imperative.

Occasionally such a gland will go on to abscess formation, though most prostatic abscesses occur as the result of either urethral instru-

mentation during the acute stages of posterior infection or digital trauma to an acutely infected gland

The symptoms of posterior urethritis like those of anterior infection may have added to them the symptoms of other infective complications which will be discussed under their appropriate headings. For purposes of brevity and clarity these will be placed in that portion of the text following the treatment of gonorrhea.

HYGIENE.

Unquestionably in the past we made life more miserable for the patient with gonorrhea than was necessary by insisting upon a lot of restrictions in diet and personal hygiene. We prohibited so many things that it was impossible for a patient to follow our instructions. Things that we now know do not influence the course of the disease one way or another. This habit has not been entirely discontinued and there is a real need for a more general understanding of the questions involved to the end that such a multitude of prohibitions be discontinued in order to let the patient concentrate upon the few that really count. The things that really do count are sexual excitement and alcohol always and excessive physical activity in some patients.

Food.—Other than alcohol the writer knows of no article of food or drink that has the least unfavorable influence upon the course of gonorrhea. For this reason he does not place any restrictions upon them. The burning that exists in some cases is a matter of local nerve end reaction to the toxins of the infection and not the consumption of condiments. Nor does the prohibition of condiments banish it. The patient who is annoyed by painful erections does well to avoid stimulants such as coffee not because they have any direct influence upon his infection but because they induce restless sleep.

The value of the consumption of large quantities of water in acute stages of anterior urethritis is overrated in those patients in whom burning on urination is not a marked symptom. It seems to have little if any influence upon the infection. In acute posterior infection with its vesical intolerance to any quantity of urine, forced fluid intake increases the misery of the patient. That the inhalation of alcohol fumes exerts the same influence upon the course of gonorrhea as does its oral consumption is shown by the behavior of the disease in those working in plants where alcohol is made. Ether exerts a like influence and gonorrhea rarely behaves worse than in hospital interns on nose and throat service where they constantly inhale its fumes.

Physical Activity—Assuredly there is little need in the absence of complications requiring it, in placing male gonorrheal patients in bed. Usually the activity to which a patient is accustomed will have no deleterious influences upon the course of his disease. It is wise to advise against strenuous physical exercise as there are a fair number of patients who are unfavorably influenced by it. These patients, however, are readily identified by the fact that they have a definite

increase of purulent discharge after such exertions, which increase usually continues for from twelve to twenty-four hours. The patient in whom this reaction does not occur need not be too closely restricted. Unquestionably, horseback riding and long automobile trips should be avoided. Particularly is this true of the latter, for it is rare to see one who repeatedly takes long auto trips have a mild attack of gonorrhea. Not only do these patients have severe anterior symptoms but they almost invariably have a more severe posterior infection which is likely to cause much prostatic swelling.

While it does not come under the heading of physical activity it is worthy of note that married men who sleep with their wives rarely have mild attacks of gonorrhea. In them the disease usually is long continued and posterior involvement is the rule.

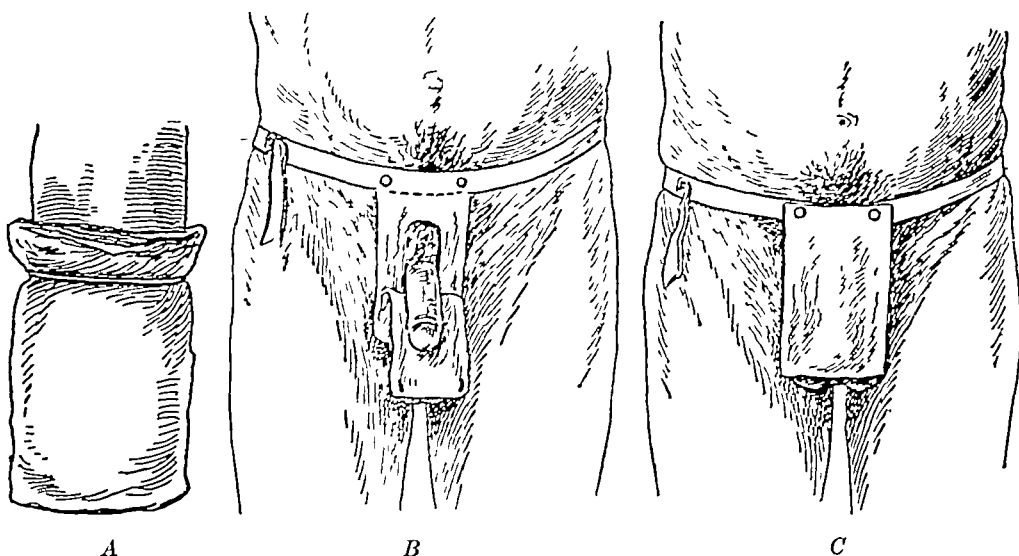


FIG 177 — *A*, Temporary cotton dressing held lightly by rubber band. *B*, Sanitary bag. This is the most satisfactory penile dressing. In the bottom of the pouch can be placed cotton or, preferably, gauze. If sufficient of either is properly used drainage is not interfered with and the clothing is well protected. *C*, Sanitary bag closed.

Personal Hygiene — The knowledge that the gonococcus almost immediately is killed by soap solutions is highly important to the patient. Fortified with this knowledge he becomes less of a menace to himself and the female members of his family. He should be instructed to wash his hands with a good soap lather after handling his penis or its dressing, and to wash the parts in the same way. If he uses a bath-tub used by others he should urinate and wash his genitalia before getting into it and soap the tub when he is through with it.

The type penile dressing needed depends upon the amount of discharge present. If the discharge is profuse a sanitary bag with some loosely packed gauze in the bottom of it should be used. If there is very little discharge the so-called butterfly dressing is sufficient. This is made by cutting a slit in a piece of bandage gauze so that the glans

penis may be pushed through it, the gauze is then pulled forward and held by the prepuce. When the discharge ceases no dressing is needed (Figs. 177, 178 and 179).

The wearing of a suspensory plays no role in the prevention of epididymal infections which are due to other causes than the position of the testes.



FIG. 178



FIG. 179

FIGS. 178 and 179 — Old butterfly type of penile dressing. This dressing is not sufficient to prevent the soiling of the clothing where colored solutions have been injected into the urethra. It is a satisfactory dressing for the collection of urethral discharge, however. (Pelouze: *Gonorrhea in the Male and Female*, courtesy of W. B. Saunders Company.)

While conjunctival infections occur only with great rarity in adults in this country, it is well to instruct the patient to avoid rubbing his eyelids for some time after he has handled his genitalia. In Asia Minor conjunctival infections take place with extreme frequency.

THE TREATMENT OF GONORRHEA.

Preliminary Considerations — On approaching the treatment of gonorrhea there are a number of things that should be in the physician's mind if he would be of the greatest good to his patients. Perhaps the most important of these is the fact that gonorrhea is a disease against which the patient must build up an immunity, as he must against other infectious diseases. In other words, cure really depends upon the patient's ability to develop these immunity responses and

we, as physicians, help or hinder these processes according to the things we do therapeutically

It is much in evidence that these immunity responses are developed in the infected mucous membranes rather than in the system at large. Thus cure is dependent upon mucous membrane reactions, and just so soon as we lose respect for these membranes we are in harmful territory.

We are equally if we lose sight of the things the patient himself may do to check curative responses. It can be said without fear of successful contradiction that no treatment is effective treatment in a patient who indulges in sexual excitement, coitus or the use of alcohol. Thus, it will be seen that nothing in the way of treatment approaches in importance proper patient cooperation to the end that he does not allow these factors to come into the disease picture. It is largely through lack of this control that the general picture of gonorrhea in the male is such a sad one.

It is because of this that drug-store treatment is such a miserable makeshift, for under it the patient is the sole judge of conduct and cure. It is for this reason that frequent contacts between the patient and an interested physician are so essential. In the absence of these contacts the patient often views the disease far too lightly and is prone to try sexual experiments long before he is cured. To this tendency are to be attributed thousands upon thousands of our gonococcal infections. There are few fields in all the realm of medical practice wherein patient control pays greater dividends in disease cure and disease prevention than is the case with gonorrhea. Under the older ways of viewing the question of treatment there were few types of patients in which control and cooperation were more difficult to obtain and hold.

Throughout the years the medical profession has approached the treatment of this disease as though cure depended alone upon it and its treatment efforts. This attitude was soon taken by the patient and when things did not go to his liking he either went to another physician or stayed with the original one and grumbled. Frequent repetitions of these experiences were bound to engender a dislike for such patients and a corresponding disinterest in the disease. This in its turn tended toward too much routine in therapeutic efforts and too little respect for the patient's psychology. Under such circumstances it is hardly to be wondered that confidence was lost, or never instilled, and that gonorrheal patients were among the most persistent changers of physicians.

This unhappy state of affairs is rather easily altered if things are put in their proper places and the patient used with fairness and frankness. In the present state of our knowledge we have little room for conceit regarding our ability to cure an infection much of which lurks within a few millimeters of a surface to which we so easily can apply treatment. He would be foolish indeed who boasted of his ability to accomplish by his treatment alone the things for which the

patient so ardently hopes. We admit to ourselves that the bactericides we inject do not do good because they reach the gonococci that are responsible for the long duration of the disease though we are prone to plan treatment as though we thought killing bacteria was the sole consideration. And the patient soon takes the same view and is only too glad to place the entire matter of treatment upon our shoulders.

If, on the other hand we take the trouble to convince the patient that cure really depends upon his own ability to engender the proper immunity responses and that he cannot possibly do this unless he absolutely deletes from his daily life those things which surely retard or prevent cure the entire patient contact picture is changed. He does not think less of us or our treatment by being told that our parts in cure are the carrying out of measures that experience has shown us have the power to stimulate his immunity responses, perhaps limit the number of complications, usually reduce the severity and duration of the disease and we do not leave him in a fool's paradise of supposed cure while the disease is still present.

A patient apprised of these things usually becomes a most cooperative one who does not try to place upon the shoulders of his physician the responsibility for things due solely to his own derelictions, nor does such a patient drift from doctor to doctor in search of something that seemingly none of us has. From a potentially dissatisfied one he is changed to one whose visits are not dreaded who trusts his physician and who does not expect the impossible.

One should not expect too much understanding of these things from a patient who has just learned that he really has a gonococcus infection. Such a patient, particularly if he happens to be married has far too busy a mind at such times to absorb much new information. It therefore, is highly important that the entire matter be repeated at one or more subsequent visits. In fact, it is wise to under rate rather than over rate the powers of comprehension of these patients and constantly to harp upon the need for the strictest cooperation if one would obtain the best results from his therapeutic efforts.

Therapeutic Measures.—Oral Medication.—So far science has given us no substance which when taken orally has any marked curative influence upon gonorrhea. In fact, there is much reason to believe that the centering of attention upon oral medication has done much to retard our knowledge. Certainly it has allowed many patients to drift into conditions that could have been avoided by concentration upon the local attack of a local disease.

The idea that urinary antiseptics orally administered influence gonorrhea fostered largely by those who make the antiseptics, has been one of the most unfortunate roads we have travelled. It has caused the withholding of much needed treatment, has encouraged self-treatment on the part of the patient, has been grasped by those druggists who treat such patients illegally and has done untold harm.

In order to be effective in urethral gonorrhea a urinary antiseptic

would have to do more than affect surface bacteria during the moment of urination. It would have to cause either a true local immunity stimulation or a real deep tissue sterilization. There is nothing to suggest that it does the former and less to indicate that it does the latter. After much observation in this regard extending over a number of years, the writer has no hesitation in saying that he sees no curative value in them and feels that even as placebos they are a costly imposition upon the patient. They do neither local good nor harm.

Nor does he feel that he need make a greater exception of the balsamics from a curative standpoint. It is true that they, particularly oil of sandalwood, often have the power of reducing the purulent discharge. Just how they do this is a mystery, but it is not difficult to demonstrate that this reduction of discharge differs from that resulting from increasing immunity responses. The discharge returns when oil of sandalwood is discontinued and the gonococcus is still present. There is abundant reason to think that such medication by balsamics is a great social menace in that it hides the visible evidences of infection while infection still is present. To it can be attributed countless transferences of the disease to others.

There are, however, other drugs that find special indications in the presence of certain sensory symptoms. These are largely anodyne in type and do not differ in their indications or use from those called for by pain or discomfort in other portions of the body. Those most in use are codeine, bromides, hyoscyamus and belladonna in doses appropriate to the symptoms they are to relieve. At times the question of loss of sleep urges the wisdom of the barbituric acid derivatives, but these should be used sparingly, particularly in the presence of acute posterior infection wherein great vesical distention should be avoided.

The patient who experiences marked burning on urination frequently is made more comfortable by alkalization of his urine. For this drachm doses of sodium bicarbonate an hour after meals commonly are used.

Hydrotherapy —The use of hot hip baths often seems to give much relief in the presence of marked vesical discomfort. They are of equal service in other acute inflammatory conditions of these structures.

Cold water applications are of particular service in overcoming or discouraging painful erections.

Local Treatment —It is in the application of local treatments to mucous membranes infected by the gonococcus that gentleness of procedure registers its highest value. Such membranes, often strained to their utmost of vital endurance, are the ones upon which we must rely for cure, and it requires but little observation to show that trauma has no place in such treatments. We here are dealing with an extremely delicate mucous membrane infected by an organism that has passed into the depths of its many small mucous offshoots, an infection the cure of which rests largely in the drainage possibilities of these small channels. To injure their openings by either instrumental or chemical

trauma is to favor intermittent drainage that most favorable of all factors for chronicity of infection

Apart from the dangers of drainage interference from such trauma there looms that of deep mucosal infiltrations with their later scar-tissue formation and stricture. There likewise exists the fact that a large percentage of the complications of gonorrhea are to be attributed to the trauma of some forms of treatment rather than to the gonococcus alone

Perhaps one of the most valuable rules that can be made regarding the local treatment of gonorrhea is not to pass any instruments into the canal while the gonococcus is present unless absolutely compelled to do so to relieve a urinary retention. Such a rule immediately throws into the discard during the course of gonorrhea such things as medicated bougies, instilling syringes, sounds, catheters, Kollmann dilators and endoscopes. Though there are those who will resent such a sweeping prohibition the fact remains that they are ill advised procedures for such an infection. Their possibilities for harm far outweigh their supposed value. Gonorrhea can be treated better and more safely without them

Substances Used—Considering that what we are trying to do is to promote tissue drainage and stimulate local immunity processes it is obvious that nothing should be applied to such mucous membranes that could injure them in any way. Consequently whatever chemicals are applied to them should be sufficiently weak and non irritating to avoid such injury. The heroic days, when it was the custom to use strong solutions because they had greater germicidal powers are gone and we are beginning to realize that what we are after is a favorable action upon mucous membranes and not a lethal one upon the gonococci. It requires but little experience to prove that gonorrhea does better on mild than on excessive mucosal stimulation. Also it is not difficult to show that even mild applications can be made too often. In fact, most patients do far better on one or two such treatments than on a greater number during the twenty four hours

It further is a fact that the more treatment delegated to the patient the greater are the number of avoidable complications. For which reason it is far better for the physician to carry out the treatment himself. Where this is not possible the utmost care should be taken to instruct the patient carefully as to the procedure and the amount of chemical to be used

The mucous membranes of different individuals vary greatly in their tolerance to chemical applications. The laying down of fixed rules as to the strength of such solutions therefore is not a simple matter though one rather safely may lay down some rules regarding mucosal reactions that apply in most cases. The mucous membrane of the anterior urethra normally shows a purulent response to the injections of any irritating chemical. The stronger the solution the greater and more continued is this response. In gonorrhea it is best to avoid those strengths that increase the discharge for more than a few hours.

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Astringents—These are mentioned solely to condemn them. They have the power of hiding infection by artificially checking discharge. They exert little if any curative stimulation and present a very definite social menace by often giving a false appearance of cure.

Hand Injections—The most common method of treatment used in urethral gonorrhea is the so-called hand injection. In the giving of such injections it is common custom to use a blunt pointed glass syringe with a rubber bulb. With such a syringe it is easier to be gentle in manipulations than was the case with the older piston syringe.

Not only may this syringe be used for injections into the anterior urethra but with it the safe injection of fluids past the cut-off muscle into the posterior urethra and bladder is a simple matter. As a matter of fact it usually requires far less pressure to give intravesical injections in this way than is the case with hydrostatic pressure. The smaller the apparatus used the less patient apprehension does it occasion and the less the apprehension the less is the spasm of the cut-off muscle.

In the giving of anterior urethral injections it is highly important that the patient void urine to wash out any urethral pus before the injection is given. It should be remembered that the anterior urethra often is entirely filled by as much as 8 or 10 cc. of fluid. Thus if one would avoid forcing some of the fluid into the posterior urethra it is best to inject not more than 5 or 6 cc. of fluid. If this rule is adhered to none of the solution will pass into the posterior urethra even after prolonged retention of it, and surely if the posterior urethra is not infected there is neither rhyme nor reason in allowing fluid to pass from the infected anterior portion into it. In fact such a procedure is rather a sure way in which to precipitate posterior infection.

After fluid has been injected into the anterior urethra it should be kept there for from five to ten minutes. To avoid the tiresome procedure of digital compression of the urethra it is the custom to use one of the many excellent penis clamps made. The writer has found the one illustrated in Figs. 180 and 181 the most convenient for his purpose.

If it is desired to cause solutions to pass into the posterior urethra they should be injected slowly and with only sufficient pressure to make them pass the sphincter. The less fuss one makes about this the less pressure does he require. In fact, if done slowly the pressure required is so little that it cannot cause anterior urethral trauma. It is accomplished more readily if the patient is not informed of the physician's purpose of giving a posterior injection.

In anterior urethritis the hand injection is practically the only method that lends itself to moderately safe patient use. As has been said it can do much harm if roughly used and it never should be prescribed unless the patient is carefully instructed in its use.

Irrigations.—The use of hydrostatic irrigations can be made a highly dangerous procedure if too much pressure is used. It was because of these high pressures and the damage they did that the method fell

One also may be guided to some extent by the sensory disturbance occasioned by the presence of the substance in the urethra. As a general rule it may be said that a solution that causes great urethral burning is too strong for the given urethral mucous membrane. In this regard, however, it should be remembered that the pain sense here differs from day to day, so that a solution that causes much burning one day may be borne with little or no discomfort the next day.

Of the solutions most commonly used in this country in the treatment of gonorrhea and the strengths appropriate for most cases might be mentioned the following:

Permanganate of potash	1 to 8000
Silver nucleinate	5 per cent
Protargol	0.25 to 0.5 per cent
Argyrol	5 per cent
Neosilvol	5 to 10 per cent
Neutral acriflavine	1 to 3000
Silver nitrate	1 to 10,000

Potassium Permanganate — This substance is most commonly employed for irrigations wherein large quantities are used. Used in proper strength it frequently has a remarkably salutary effect. It lends itself to use twice a day without any great mucosal irritation. The writer values it so highly that, if limited to one substance in his treatments, it would be his first choice.

Protargol — This stronger one of the silver proteins makes an excellent solution for use by the patient himself. In strengths ranging from 0.25 to 0.5 per cent, it is well borne, has an excellent curative stimulation value and has the advantage of not staining fabrics. It may be used twice a day.

Silver Nucleinate — The writer's experiences with the commercial preparations of this milder silver protein have made him partial to it. He has found it in his hands to give results superior to its near and more expensive twin Argyrol. Both have the disadvantage of staining clothing and are best used by the physician himself.

Neosilvol — This far milder silver preparation seems not to give such good results in the treatment of gonorrhea as are obtained from the foregoing. It, however, seems at times to start immunity responses in mucous membranes not showing a favorable reaction from other substances. In non-specific urethritis it, at times, has almost a specific action.

Neutral Acriflavine — This substance has found much favor in many quarters. In 1 to 3000 solutions it causes but a transient purulent response and often is of benefit. Its staining qualities are great.

Silver Nitrate — Though formerly much used, silver nitrate largely has been abandoned. At times it exerts a very beneficial action in patients showing poor immunity response. It has a tendency to be followed by prolonged shred formation if used over any length of time. It is perhaps more stimulating than most of the things used, for which reason it finds its best field of use in long-continued, sluggish infections.

patient void. At the end of the treatment it usually is well to leave some of the irrigating solution in the bladder.

Instrumentation.—As previously has been stated the passage of instruments into the gonorrhoeal urethra is a dangerous procedure. Thus, intra urethral instruments are best avoided as methods of treatment for gonorrhea. After the gonococcus seemingly has disappeared from the scene their use is of definite value. The trauma of their passage is a potent way in which to stir into activity possible hidden foci. For this reason the passage of sounds becomes a valuable part of our tests of cure.

Sounds also are of value in the reduction of deeper mucosal infiltrations as well as in the treatment of localized mucosal denudations after the gonococcus is gone.

If only the anterior urethra has been infected care should be taken not to pass such instruments past the cut-off muscle until it is shown that the gonococcus no longer is present.

The writer considers the Kollmann dilator a very dangerous instrument and much prefers the urethral sound.

The sound or olivary bougie is of use in our 'proofs of cure' of gonorrhea as well as in the discovery of urethral narrowings.

The instilling syringe has no place in the treatment of gonorrhea for the reasons repeatedly set forth. In non-gonococcal infections of the posterior urethra and bladder it is of value in that it allows of the introduction of substances that would be extremely painful and injurious to the far more sensitive anterior urethral mucous membrane.

Vaccines and Sera.—Unquestionably the vaccine method has been one of the most disappointing in all of our therapeutic efforts to control gonorrhea. Both observation and experience have convinced the writer that the surest way to make urethral gonorrhea severe and long continued is to use vaccines as usually recommended. It is apparent that the immunity balance in this disease is one of the most delicate of which we have knowledge. Because of this it is easily overwhelmed by systemic injections of gonococcal toxins.

It is the writer's opinion based upon both experience with the preparation and observation of patients upon whom it previously had been tried, that the Corbus-Ferry Filtrate exhibits little if any curative stimulation and he has seen it to great harm. He has been utterly unable to duplicate the reported experiences of both Corbus and Cummings.

While the use of vaccines for urethral gonorrhea is highly lauded in Europe it is a fact that when we use their vaccines as they advise them we obtain uniformly poor results. Surely if they get the results they claim, then our race presents some marked biochemical differences differences that cause vaccines to play havoc with them. Whether the English vaccines made from gonococcal fractions will serve us better remains to be seen but it is probable they will go the way of all the others.

In urethral gonorrhea the use of antigonococcal sera has proved

into disrepute in many quarters To avoid these dangers there should not be a water pressure of more than 2 feet for anterior irrigations nor $3\frac{1}{2}$ feet for intravesical irrigations

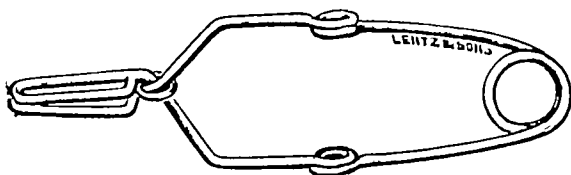


FIG 180 —Author's clamp for retaining fluids in the anterior urethra (Pelouze, *Gonorrhea in the Male and Female*, courtesy of W B Saunders Company)

In the giving of anterior irrigations it is best not really to give even 2 feet of sustained pressure to the canal for fear of forcing the sphincter The canal should be distended gently with fluid, this should be allowed to escape and the procedure repeated

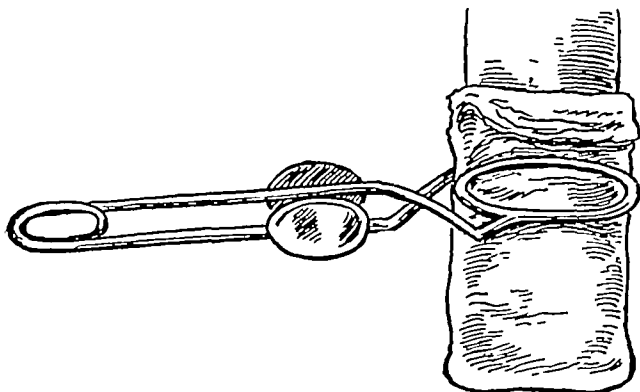


FIG 181 —Method of using the author's penis clamp A fold of absorbent cotton is passed over the meatus and back along the shaft of the penis before the clamp is applied (Pelouze, *Gonorrhea in the Male and Female*, courtesy of W B Saunders Company)

In the giving of intravesical irrigations by hydrostatic pressure, one's success usually is greater if he uses a small urethral nozzle and does not make it appear as a great undertaking It is not possible for all patients immediately to relax the urinary sphincters, but, with patience on the part of the physician, most of them experience but little difficulty in doing so If one does not succeed at the first effort it is far better to try at a later visit than to force the sphincter by increasing the water pressure greatly

The use of catheters for such irrigations is to be deplored Not only does this procedure increase the number of complications in any group of cases but it tends to prolong infection If it does nothing worse it so traumatizes the urethral surface that the patient passes shreds in his urine long after he is cured of his gonorrhea

In the presence of active posterior gonorrhea there is a great danger of precipitating epididymitis in overfilling the bladder Consequently, it is better procedure only partially to fill that viscus and have the

applied by the physician. It is only possible to approach such a figure in cases seen during the first week of the disease and under strict patient control. The number of posterior involvements in patients seen after the first week steadily mounts until it reaches the discouraging figure of 90 per cent.

If for any reason the patient is unable to present himself daily or must absent himself during the course of treatment he is given some 0.5 per cent protargol solution a bulb syringe holding not more than 6 cc. instructed in the method of giving himself an injection and told to give a treatment night and morning.

Occasionally in cases that seem not to be improving as well as is hoped the patient is instructed to give himself such an injection twelve or fourteen hours after his office treatment.

Regarding the use of other chemicals it should be said that in other hands they have found great favor. It probably is not so much what one uses as it is how it is used and in what strength. We are after mucosal stimulation and unquestionably there are a host of things that will cause it.

The patient with only anterior infection having reached a stage where his urine is clear and there has been no urethral discharge for at least three weeks is in a condition warranting the exhibition of those somewhat uncertain things that we have nominated our proofs of cure.

Proofs of Cure.—Our efforts at proving cure are predicated upon the fact that so long as the gonococcus is present it should be possible to stir the infection into a degree of activity wherein the gonococcus can be found microscopically. They are not true proofs but inferential ones wherein errors easily are possible. For this reason they should not be trusted too implicitly and he is a wise doctor who makes no positive statements beyond the fact that the patient has responded negatively to them is probably well but would be fairer to his women friends if he prevented them from being the victims of such uncertain knowledge by having no sexual contacts for three months without the use of a good condom.

The writer's first effort to this end is the passage of a full-sized acorn sound to but not through the cut-off muscle. The patient is provided with slides for the collection of any discharge that may appear. This having produced no signs of disease as evidenced by no urethral discharge and a negative sediment in the first glass of urine, a full-sized solid sound is passed to the cut-off muscle and the entire anterior urethra firmly massaged upon it. This having proved negative the patient is allowed some alcohol and sexual excitement (not coitus) and if this fails to show any evidences of infection he is given the above instructions and told that he is probably but not surely well. At times 0.5 cc. of gonococcal vaccines are used hypodermatically as an extra precaution. The writer's confidence in the complement fixation has not led him to its employment as a proof of cure.

equally disappointing. While they do not seem to influence the infection adversely, as do vaccines, they exert no curative influences.

Case Treatment of Acute Anterior Infection.—The local treatment of acute gonorrhea is best started as soon as the diagnosis is made. There certainly is nothing to be gained and much to be lost by withholding treatment until the subsidence of acute symptoms, as has so often been advised. In those patients in whom treatment is delayed the percentage of posterior infections is upwards of ninety-five. By instituting gentle treatment during the first few days of infection such posterior involvement can be prevented in a highly attractive percentage of those patients who refrain from alcohol and sexual excitement. Considering that most patients who have an anterior infection only are well in six weeks and few who have a posterior infection are well in less than five months, efforts to prevent the latter extension are well worthwhile.

To conserve space the writer first will outline the treatment that has given him the best results before generalizing upon the question of treatment.

The patient is instructed to pass his urine in two glasses. The anterior urethra then is carefully irrigated with 1 to 8000 potassium permanganate solution, using probably 8 ounces.

The permanganate solution is allowed to drain out and 5 or 6 cc of a 5 per cent silver nuclemate solution is then gently injected into the anterior urethra, a cotton pad is placed over the penis, a clamp is placed over this and the solution is held in for five or more minutes depending upon the discomfort it engenders.

The silver nuclemate is allowed to drain out and a cotton pad, held in position by two No. 10 rubber bands, is left on the penis. This is to be removed for the next urination and replaced. After the second urination it is removed entirely, the patient being carefully instructed not to wear the rubber bands thereafter.

This treatment is carried out daily for two weeks in the most favorable cases, three weeks in those progressing less satisfactorily. Good progress is registered by the disappearance of discharge and the practical clearing of the urine. If at the end of two weeks this has not taken place the daily treatments are continued for the third week.

By this time the patient usually has reached a state where he does equally well on treatments every forty-eight hours, later every seventy-two hours.

No efforts are made to see if cure has taken place until five weeks have elapsed. Efforts in this regard before the expiration of five weeks frequently stir up reactions that are quieted down with much difficulty or not at all without posterior involvement.

Under this simple plan of treatment anterior urethral complications are exceedingly rare. About 20 per cent of the cooperative cases have a posterior involvement. While this percentage seems an admission of failure it does not nearly approach the percentage of such extensions in patients on self-treatment, or on less gentle forms of treatment.

increase in symptoms it is repeated in three or four days and stroking is substituted for light pressure only after the former has produced no reaction of any type. At subsequent treatments this stroking is done with increasing firmness until it is found safe to carry out what we understand as real prostatic massage. These strokes are made from above downward over the lateral lobes the mid line being avoided until real massage is proved safe (Figs. 182 and 183)

Later when there is reason to believe the gonococcus no longer is present the irrigations are stopped, the patient is instructed to visit

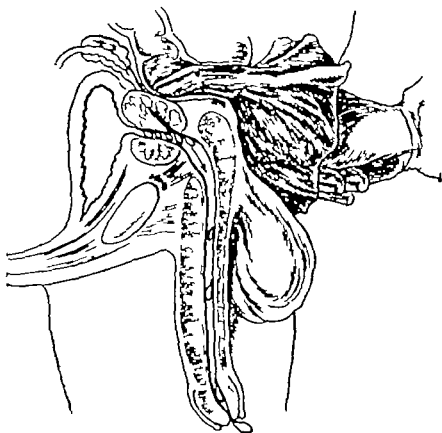


FIG 184 --Method of obtaining the prostatic fluid for microscopic study. Note the single glove finger with the cap for the protection of the hand. After Marion. (Pelouse Gonorrhea in the Male and Female courtesy of W. B. Saunders Company)

the office with urine in his bladder. He passes a small portion of this in a glass and if it shows no reason to the contrary massage is carried out and the patient passes the rest of his urine to flush out the products of the massage (Fig. 184)

Irrigations are discontinued in order to give the urethral mucous membrane an opportunity to overcome the common influences of repeated chemical insults. In this way by the time the patient is through with his postgonorrheal prostatic infection his urethral mucous membrane is through forming shreds to disquiet him.

The prostate gland is never massaged oftener than twice a week.

Acute Posterior Urethritis.—With the onset of acute posterior involvement the treatment picture changes and, while it does no harm to continue anterior urethral treatment, it does no real good beyond the possible reduction in anterior urethral discharge. The infection now is in structures that so often resent interference while they are acutely inflamed that it is certainly safest to withhold any efforts toward intravesical treatment until the patient has regained his bladder comfort. Thus, the patient generally is given a mild anodyne, told to make no great effort to hold any large quantity of urine in his bladder and particularly to avoid great physical exertion while there is any quantity of urine in his bladder, if he would avoid epididymitis.

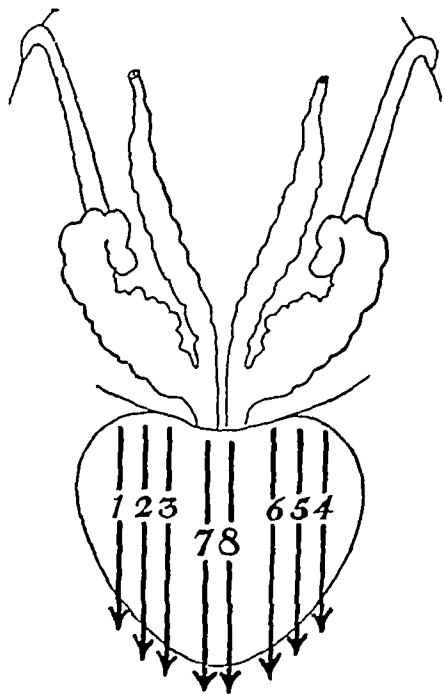


FIG 182

FIG 182 —Direction of the stroking of the prostate gland. By leaving the mid-line strokes until last the discomfort is reduced to a minimum and is at the end of the treatment.

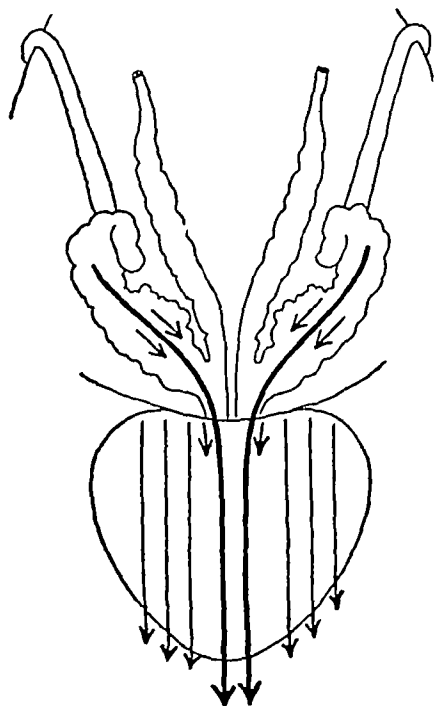


FIG 183

FIG 183 —Prostatic massage and stripping of the seminal vesicles (Pelouze, *Gonorrhea in the Male and Female*, courtesy of W. B. Saunders Company)

When such a patient has regained his vesical comfort an effort is made to give him hydrostatic intravesical irrigations of 1 to 8000 potassium permanaganate solution as previously described. These are repeated daily for a few days, then every other day and finally twice a week.

When the second glass of urine has become perfectly clear and the first glass practically so, thought is given to the associated prostatic infection. This is approached with extreme gentleness. Some potassium permanaganate solution is left in the bladder and very gentle digital pressure is made to the lateral prostatic lobes. If this occasions no

should be given from three to five days apart. To exceed these figures often has the opposite effect of putting immunity effort in abeyance for weeks or months.

Occasionally these patients are improved by resorting to irrigations of 1 to 10 000 silver nitrate at twenty-four or forty-eight hour intervals. Some patients are the victims of poorly-draining bacterial feeders usually in the prostate and are improved by gentle prostatic massage. More rarely the feeder may be an infected seminal vesicle in which case vesicular stripping at forty-eight hour intervals often will produce improvement. This latter group of cases readily may be discovered by the fact that they experience a marked recrudescence of symptoms after each involuntary seminal emission as will be shown later.

A strikingly large proportion of the patients who are tardy with their immunity responses have been given a course of large doses of gonococcal vaccine during the early weeks of the disease. So commonly is this the case that it offers one of our strongest arguments against the efficacy of such methods, particularly early in the course of gonorrhea. Corbus-Ferry Filtrate frequently has a like effect.

The presence of old urethral strictures at times explains the prolongation of the infection. In other cases there is a history of much traumatic treatment, treatment highly inappropriate when applied to a mucous membrane so sorely tried by infection. We must rely for cure upon the infected mucous membrane itself and a membrane devitalized by either instrumental or chemical trauma is sure to lag in the development of curative response.

Not only do the factors above mentioned tend to prolong infection but they rather commonly are the precipitating factors underlying many of the needless complications occurring in such patients, for it is among such patients that most complications occur. A comparison between the number of such misfortunes occurring in gently treated cooperative patients and in traumatically treated non-coöperative ones furnishes conclusive argument in favor of the former. Aside from posterior urethral involvement at least 70 per cent of the complications of the disease are found in poorly behaved traumatically treated individuals. Under ideal conditions of treatment and conduct epididymitis is rare and phimosis, paraphimosis, follicular abscess, Cowperitis, lymphangitis, phlebitis, arthritis and acute prostatic swellings or abscess are even more so.

Such being the case it is obvious that gentleness of therapeutic procedures and endless efforts toward obtaining patient cooperation are the surest ways to make this disease a mild affair unassociated with those complications that are so distressing and dangerous to the patient.

Acute Prostatitis.—Though the prostate gland becomes infected in every case of posterior urethral infection by the gonococcus the condition is usually clinically silent. There however, do occur cases in which the gland swells enormously, causes rectal discomfort and perhaps difficulty in urination. Usually there is an associated rise in

and it is not massaged at all if there is any reason to believe that harm is likely to eventuate from it. If, after some weeks of massage, there still is a large amount of pus in the prostatic secretion attention is turned to possible tooth or tonsillar infections as a possible reason for lack of improvement. If these are not present the question of a few weeks' rest from massage should be considered at the end of three months of prostatic treatments. After this another effort should be made to cure the residual prostatic infection. Not only is this of importance from a focal infective standpoint but it is important by virtue of the fact that at least 75 per cent of our cases of non-specific urethral discharges occur in patients who harbor an infection in this gland. The mental anxiety of the patient who has had a recent gonorrhea when a discharge appears as the result of alcohol or coitus is a thing to be reckoned with and prevented.

THE CLINICAL VARIANTS.

While the usual case of gonorrhea lends itself to a plan of treatment that allows of much uniformity, it should be understood that there frequently are clinical variants that tax the skill of the physician. As a general rule these variations have to do more with patient conduct than with true disease vagaries. But it is by no means rare to encounter patients who, though scrupulously cooperative, remain in a stationary state for a considerable length of time. Upon rarer occasions some of them display a marked irregularity in the course of the disease.

In the treatment of such patients one should avoid the tendency to try a vast assortment of methods, giving none of them a real opportunity to exercise the hoped for good. They vary in clinical course, not because they have more virulent gonococci, but because they biochemically furnish better cultural environment, with a less ready power to engender immunity responses of the proper sort.

Before assuming, however, that a given patient is what rather appropriately might be called, a biological variant, it is highly important to rule out both treatment and conduct factors that could produce like influences. Particularly is this so in the presence of marked irregularity in the clinical manifestations of the disease. With the exception of the first few weeks of the infection, it is extremely rare to see gonorrhea uninfluenced by these banal factors, run a markedly irregular course. With very few exceptions such irregularity is due to things the patient does. If he is not indulging in alcohol or sexual excitement he is taking very long automobile rides or is one of those patients adversely influenced by other activity.

What is to be done for these "biological variants"? In the present state of our knowledge there seems to be little other than the time factor that offers much. All of them, gently and persistently treated sooner or later will muster up sufficient immunity response to overcome the disease. Occasionally they respond favorably to three or four small doses (10,000,000 to 50,000,000) of gonococcal vaccine. These

didymes and the occluded urethral follicles. If on the other hand it could discharge its contents into the urethra the contained gonotoxin would occasion a profuse urethral discharge within twelve hours of such an occurrence after an involuntary emission. Hence it cannot be of frequent occurrence.

As gonorrheal seminal vesiculitis is so rare, acute fulminating gonorrheal seminal vesiculitis is one of the most extreme rarity, so rare in fact that one is hardly likely to encounter it in even a large urological practice. The writer is still looking for his first case, though others seem to encounter many of them.

So far as the treatment of gonorrhea is concerned one need worry but little about the seminal vesicles except in those patients experiencing an acute urethral reaction following the expulsion of the vesicular contents. In them he should bend his efforts toward digital stripping of the sac. To avoid the accumulation of too much gonotoxin between these strippings, it is wise to repeat these efforts every other day until the patient no longer experiences urethral reactions after emissions. While it is true that the entire vesicle often cannot be reached and emptied by the finger in the rectum, it is equally true that such drainage as is possible usually produces cure if done often enough.

Seminal vesiculectomy or vesiculectomy for gonorrhea rarely is indicated if one has the patience to treat the lesion. The same can be said of injections by way of either the ejaculatory ducts or vas. While these efforts may do no harm they are not in any sense necessary and are not of a very high curative value. They largely have gained their reputations by being used for lesions that in reality did not exist.

It is hardly necessary to state that vesicular stripping should not be done during the early stages of posterior infection. This procedure should be delayed until prostatic massage is safe.

While as has been said operative intervention for gonococcal infection of the seminal vesicles is rarely necessary, there occur cases wherein it may be a wise procedure. Particularly may this be so in the presence of persistent arthritis uninfluenced by local treatment to the prostate and vesicles, and proved not to be due to other infections. One cannot deny that some patients of this type have been cured by seminal vesiculectomy, nor could he deny that many patients have been subjected to it needlessly. Seminal vesiculectomy is a difficult operation which only should be attempted by one thoroughly skilled in perineal surgery. In unskilled hands the operation carries dangers that are not to be viewed lightly.

Cowperitis.—Most infections of Cowper's gland are found in patients with known neglected strictures or in whom high-pressure urethral injections have been used. They almost never occur in other patients. When infected Cowper's glands usually suppurate, point to their own sides of the bulbar urethra and demand surgical drainage.

Chronic Cowperitis occasionally does take place. Such patients usually exhibit gonococci in a scanty urethral discharge for long

temperature, in some cases to 103° F or higher, and an enormous increase in leukocytosis. The clinical symptoms are highly suggestive of abscess formation which is further suggested by long continued leukocytosis. It, however, is rare for such glands to undergo true abscess formation. At least 95 per cent of them undergo resolution if rectal heat is applied to them in the form of rectal lavage.

While this condition occasionally occurs in gently treated, well-behaved patients it usually follows digital trauma in the early stages of gonorrheal prostatitis. It, therefore, takes the position of a largely preventable complication.

If the temperature rise of acute prostatitis continues for a week or more it generally does so because of abscess formation. The possible wisdom of surgical intervention then intrudes itself. One, however, should not be swayed too much toward operation by a high leukocyte count. Even in the absence of true abscess formation this is high and commonly remains so for some time after the swelling has reduced.

Occasionally one encounters an acutely swollen prostate gland that starts to reduce in size as though it were going on to resolution. Perhaps one portion of the gland will become seemingly normal in size while the other continues to be swollen. It is rare indeed that this persistent enlargement is not due to a good-sized accumulation of pus in the gland. And it is rarer for such a patient to recover safely without operative intervention. Such patients usually run an irregular temperature course. It may be normal for a day or two, then elevated and again normal. To hope for the intra-urethral evacuation of such an abscess is to run unwise risk for the patient.

Having decided that surgical intervention is required, one does best to advise the perineal approach as the safest and surest for the patient. Rectal incision of these abscesses is dangerous and unscientific, an operation that might be called a remnant of the dark ages of prostatic surgery. Comparatively few urologists have been impressed with the wisdom of opening these abscesses into the urethra by means of the tip of an urethral sound. It is a blind procedure that must require great courage on the part of the operator and in which the patient must trust to luck that things will work out to his advantage. Against both of these perineal drainage stands out as an operative procedure done under visual conditions and, in skilled hands, carrying a minimum of risk for the patient. Its curative value is far greater than either of the others.

Seminal Vesiculitis.—The writer has seen nothing in his clinical experiences to make him even suspect that gonococcal infection of the seminal vesicles occurs in any great number of patients. It is his conviction that 2 per cent would be a generous allowance. For this reason he deplors the use of the word *prostatovesiculitis* as one sure to give the impression that the association is a constant one.

If a gonococcal seminal vesicle was entirely closed off so that it could not empty its products into the urethra, it would sterilize its contents and its walls, as happens in the Fallopian tubes, the epi-

upon soldiers in the German Army to the effect that 10.5 per cent of those with gonorrhea without epididymitis had no children as against 23.4 per cent of those with unilateral and 41.7 per cent of those with bilateral involvement.

Treatment.—The treatment of this highly preventable complication of posterior urethral infection depends somewhat upon its severity. Where the condition is associated with marked rise in temperature, the patient should be kept in bed. As a rule however there is not sufficient rise in temperature or general prostration to make this necessary and under appropriate treatment, most patients may be kept ambulant.

Locally the call is for support with pressure and this may be obtained in a number of ways. The simplest way is by the employment of a heavy woven jock-strap that is a trifle small for the individual. By interposing cotton between the scrotum and the jock-strap and pulling the latter well up toward the waistline sufficient pressure can be maintained to give great relief from pain.

Failing in this, a cross spica bandage of the perineum may be used or one of the several adhesive plaster supports that have been advised. Much comfort may be obtained by Burney's method of encircling the swollen side of the scrotum with a wide rubber bandage fastened by adhesive straps.

The intravenous injection of 10 cc. of a 10 per cent solution of calcium gluconate daily for four or five days has given the writer his best results. A 5 per cent solution of calcium chloride also is of value, though it is more toxic than the gluconic acid salt of calcium.

There is little, if any, virtue to the various ointments that have been suggested and the scrotal skin stands them poorly. Heat and cold both have their advocates. Vaccines have caused such marked local reaction that sloughing of the scrotal contents ensued.

Surgical Treatment.—While surgical intervention is not needed in any great number of cases of acute epididymitis it must be admitted that it has a definite field of usefulness. In the presence of definite abscess formation it may become imperative. In the presence of high continued fever associated with great pain it is a procedure attended with the most gratifying results. To withhold it under such circumstances often is to subject the patient to much needless suffering and perhaps not a little risk. Fortunately such cases are rare.

In the presence of repeated attacks of epididymitis the operation of vasectomy deserves serious consideration. If done the proximal end of the vas should be turned back and securely fastened. To tie it and drop it back in the wound often means that it will reestablish its continuity and perhaps subject the patient to further recurrences of conditions for which the operation was performed.

Sterility.—The relief of sterility occasioned by bilateral epididymitis is deserving of careful consideration. It is rare for such sterility to be due to occlusion of the conducting structures proximal to the epididymal tube. Hence the possibility of anastomosis of the vas with

the swollen ampullar end of the vas per rectum. If possible, operation should be delayed some hours, for if the trouble is due to a descending vasitis, the differential diagnosis is not in doubt on the following day. Greater delay is unwise

Upon rare occasions this condition causes symptoms of acute ureteral block with marked renal pain. This usually clears up within twenty-four hours, however, and probably is due to transient occlusion of the lower ureter from swelling of the vas where it passes between the ureter and the bladder wall

During the acute stage of epididymitis the urethral discharge usually reduces or entirely ceases, so that the voided urine may be clear. As the acute symptoms subside the discharge gradually returns

Involvement of one epididymis and then the other is not rare, but concomitant bilateral epididymitis is quite unusual

If true abscess formation occurs resolution may take place, but more commonly the abscess points toward the skin surface and, if not incised, ruptures spontaneously

The marked symptoms of epididymitis uninfluenced by treatment increase during the first two days, remain stationary for several more, and then gradually subside. Pain usually is gone by the end of a week, though the swelling is slow in disappearing

Diagnosis.—The diagnosis of frank gonorrheal epididymitis usually is a simple matter. It should not be overlooked, however, that tuberculous epididymitis at times has an onset just as painful and fulminating. It also should be remembered that non-gonorrheal epididymitis is in no sense a rare condition, particularly in the presence of urinary obstruction

Luetic epididymitis is rarely of acute onset nor is it painful, as a rule. The swelling usually is slow in development and the condition is more likely to be confused with tuberculosis than with gonorrhea

The differentiation between descending vasitis, appendicitis and ureteral block has been cited above

The history or presence of gonorrheal discharge, together with the acuteness of the symptoms, seldom leave much doubt as to the cause of the epididymitis. Where the history is not typical and discharge is absent the gonococcus may be found in the urinary sediment or the complement-fixation test may offer a solution to the problem

Prognosis —The prognosis of epididymitis is largely a question of the production of sterility for the complication almost never causes death. There are a few recorded cases of death from peritonitis, which, though cited as due to epididymitis, were more probably due to an associated seminal vesicular abscess

The destruction of the scrotal contents by gangrene is rare, while the destruction of the epididymis by abscess formation takes place with greater frequency.

So far as the effect upon the course of the urethral infection is concerned, epididymitis at times seems to shorten it somewhat.

Bairinger cites in the second edition of this work the report of Benzla

greatest sexual activity and as this is the period wherein the incidence of venereal diseases follows much the same trend it is easy to understand why we have been so ready to consider these diseases as the main factor in the determination of conditions favoring such discharges. In this group of cases however there were 140 patients who had never had a venereal disease and at least one-half as many whose venereal disease had occurred many years before the non-specific urethritis and hardly could be a factor except in those with postgonorrheal stricture. There were 24 patients with stricture.

Another interesting point is that at least 227 of the urethral discharges were merely the reaction of the anterior urethral mucous membrane to infection back of the cut-off muscle and 44 of the discharges were composed solely of mucus and merely the hypersecretion of a normal substance. This leaves us but 62 in which the cause was in the anterior urethra though the 24 stricture patients had both anterior stricture and prostatitis.

These figures become rather striking when it is considered that it is rather a widespread custom to view non-specific urethral discharge as an indication of anterior urethral pathology and to treat it as such. They reveal rather strikingly why success in treatment has been so often lacking in brilliance. Treatment aimed solely at this portion of the canal is only appropriate for slightly over 18 per cent of the patients, and even in these success often is to be had only by elimination of the non-bacterial factors that have really precipitated the trouble. Thus it is obvious that the proper care of these patients rests largely in the determination of these things and their eradication.

One cannot take a narrow view of this question and make many of his patients happy nor does he get far by letting his mind dwell too much upon the particular bacteria present in a given discharge. It is more than likely that the patient has carried for years progenitors of those bacteria without the least sign of trouble. A better view is toward a study of factors that could upset mucosal physiology or biochemistry sufficiently to cause such an outpouring of leukocytes from its surface.

There is little to suggest that any great proportion of these cases is really due to mucosal penetration by the bacteria present as is the case with gonorrhea. In most of them the discharge apparently is more of the nature of a mucosal surface response to liberated bacterial toxins either from luxuriant surface growth or as the result of toxins emptied from an associated poorly-draining mucous channel. This is rather well borne out by the fact that attention to infection in these channels usually will obliterate the anterior urethral discharge in the absence of any treatment to that portion of the tract. Particularly is this true of the discharge associated with non-specific prostatic infections, of which there were 227 cases in the aforementioned series.

In a consideration of the subject sight should not be lost of the fact that many of the continued urethral discharges encountered are not truly the fault of the urethral membrane *per se* but are the results

the testicular hilum is well worth considering wherever the sterility is considered a misfortune and not a boon. This operation has registered many successes, carries little, if any, danger and can be recommended without fear. It, however, should not be presented to the patient in too glowing terms, as it has more failures than successes to its credit. One makes no mistake in placing the evidence before the patient and allowing him to make his own decision.

NON-GONORRHEAL URETHRAL DISCHARGE.

Etiological Considerations — The subject of non-specific urethral discharges has been a medical bugbear for many years. Considering that an almost endless number of etiological factors can cause the urethral mucous membrane to pour out pus, this is easily understood. We here are faced by conditions of a sort that cause one to wonder why such discharges are not far more frequent than they really are, for we have an anterior urethra lined by a mucous membrane of extreme sensitiveness, a membrane that pours out both mucus and leukocytes as the result of even minor grades of irritation.

We commonly find a number of different bacteria normally inhabiting the urethral lumen, living in apparent symbiosis with the tissues and with one another. Apparently this seemingly happy state of affairs is terminated with the greatest of ease by a number of things. Because of these bacteria, which usually appear in numbers in the discharge from an urethra in which this biological balance has been broken, we have thought, perhaps, more in terms of infection than in those of the things that made it possible for the evidences of infection to appear. Because much of our treatment has been aimed at infection, we largely have overlooked the things that allowed the infection to occur and persist, and our results have not always been too satisfactory. By projecting our attention beyond the actual discharge and perhaps the particular bacteria in it, we rather quickly pick up a number of things that help us greatly in our understanding of the malady and often in our treatment of it.

One of the most interesting observations in such a search is that non-specific urethral discharges are extremely rare before the age of eighteen years and almost as unusual after the age of forty-five years. Where they do occur after this age it usually is not pus but mucus. If it is pus the patient almost always has an urethral stricture, and even here we find almost as many epithelial cells as we do leukocytes. In an etiological study of 333 cases of such urethral discharges, there was none in individuals under eighteen years of age and only 9 beyond forty-five years. They ranged in numbers as follows: eighteen to twenty years, 17, twenty-one to twenty-five years, 85, twenty-six to thirty years, 84, thirty-one to thirty-five years, 77, thirty-six to forty years, 43, forty-one to forty-five years, 18, forty-six to fifty years, 5, fifty-one to sixty years, 4.

By this it can be seen that the condition is one of the period of

charge that they escape detection. If there is a suggestive history particularly if the patient is married it is a wise plan to collect one of the specimens from twelve to eighteen hours after the consumption of some alcohol before assuring the patient he has not a gonococcal infection.

If the patient complains of a discharge in the morning only he should be given a glass slide and instructed to bring a smear of it in for study. *Because this is not routinely done it is not uncommon* to see patients who have been given a prolonged course of treatment to remove a discharge that was due solely to a hypersecretion of mucus.

Not only is one interested in the bacterial content of the discharge but he often gains greater diagnostic aid from a study of its cellular content. Particularly is this true as regards the number of epithelial cells present for large numbers of these cells are a decidedly reliable indication that the discharge is due to prolonged chemical treatments to the urethra or to urethral stricture.

Having assured one's self that gonorrhea is not present by a study of the discharge he is on safe ground to proceed further with his studies. The most important of these is the study of the prostatic secretion as approximately 70 per cent of such discharges are due to prostatic infection. The prostatic secretion should be studied under the high-power lens in the fresh condition and care should be taken to assure one's self that there are no trichomonads present for such infestations are not cured by prostatic massage nor is much reduction in the prostatic pus brought about by such treatment if they are present. They should be suspected and repeatedly searched for in patients having a moderately profuse mucoid discharge associated with prostatic infection and not influenced by prostatic massage. They seldom are in the urethra and not the prostate but one makes no mistake if he studies all mucoid discharges in the fresh condition for these parasites.

Cowper's glands should be palpated as should also the seminal vesicles, though these latter seldom are a factor in the causation of non-specific discharges.

If prostatic infection is present attention should be given to the tonsils and the teeth for it is usually from oral infections that focal infective prostatitis originates as has been cited under that heading.

While it, perhaps is a good procedure to carry out a cysto-urethroscopic study in patients presenting prostatic infection of non gonorrheal origin it is not always possible or wise to do so. It however should be done in those patients whose prostatic infections do not respond to treatment. Particularly is this so if there are no oral infections to account for lack of progress toward cure for the presence of cysts or other pathology in the posterior urethra usually will prevent prostatic improvement. A study for stricture in patients with chronic discharge showing much epithelium is imperative.

Aside from these studies the history at times presents valuable diagnostic data. This is particularly true in those patients developing non-

of an effort upon the part of the urethra to protect itself against treatment onslaughts, a process in which the mucosa overdoes its work. These are easily singled out by the enormous percentage of epithelial cells found in the discharge, a condition rarely seen in other patients unless a stricture is present.

A recital of the findings in the above series will do much to show the breadth of the etiological field, though these do not in any sense cover all of the possible causes and factors at play in every case of non-specific urethral discharge. There were 237 discharges composed of pus, 50 composed largely of epithelial cells, 44 composed almost entirely of mucus and 1 was composed of semen. In 26 there was no obvious etiological factor. Some of these were seen during an epidemic of influenza and, as the pneumococcus was present in many, it is possible that influenza was a factor, as it is a singular coincidence that this bacterium is not encountered in any great number of urethral discharges except during or after an influenzal epidemic. In 34 patients there was a history of prolonged chemical treatment to the urethra and in 15 the discharge followed chemical prophylactic injections.

Many of the patients presented more than one possible causal lesion. These were as follows: Prostatitis, 227 (55 of these were of definite focal infective origin), posterior urethral cysts, 41, tuberculosis, 9, anterior urethral papilloma, 3, prostatic hypertrophy (infected), 1, prostatic abscess, 2, Cowperitis, 3, trichomonas vaginalis infestation, 3, stricture, 24. Three were evidently due to irritating postmenstrual vaginal secretions, 2 followed drinking of bad liquor and 12 followed instrumental trauma to the urethra. Though there was none in this series, one should consider a pin-point urethral meatus as a possible cause, as well as infections of the preputial sac.

Thirty-eight of the cases presented Gram-positive intracellular diplococci that could not possibly have been differentiated from the gonococcus without the Gram stain.

Diagnosis—With so many possible underlying causes and with intelligent treatment almost solely dependent upon the removal of these causes, it is apparent that there is far more to the question of diagnosis than the microscopic study of the discharge. Not that one would speak slightly of this, however, for there is no way in which the discharge can be proved non-gonorrheal except by the repeated and careful use of both the Gram stain and the microscope. To have neglected the former in this series would have been to inform the 38 patients whose discharge contained Gram-positive intracellular diplococci that they had gonorrhea when they did not, and to have neglected the microscope would have been to have added to this a deep abyss of ignorance. The world has not produced as yet the doctor who can tell gonorrheal from non-gonorrheal discharges by their clinical manifestations alone.

One should not be satisfied by a single microscopic study, for it is possible for gonorrheal patients to have so few gonococci in the dis-

never have had gonorrhea or whose attack of gonorrhea took place many years before the prostatitis in question. The average age at which postgonorrheal prostatitis occurs is between twenty five and thirty years, whereas the average age of the patient with focal infective prostatitis is forty nine years.

In postgonorrheal prostatitis the entire glandular structure apparently is infected as is evidenced by the fact that the secretion expressed from such a prostate is thoroughly intermixed with pus cells. In focal infective prostatitis the process often does not involve all of the acini and many fields of normal prostatic secretion commonly are seen. In fact the infection is so deep seated at times that pus is obtained only at a second or third prostatic stripping a finding almost never encountered in prostatitis of gonococcal origin.

Our accumulating experiences with focal infective prostatitis have served to clarify many things that heretofore have been but poorly understood and they have served to reveal a greater field of common interest between the urologist and those in other fields of medicine. So true is this latter that the urologist who plays a lone hand with this form of prostatic infection not only misses much of the clinical picture but more often renders but an incomplete service to his patients, for usually this lesion is only a part of a general pathological picture. To grasp the beginning of the story one cannot take a limited view. Not only is there some deeper physiological or biochemical reason why the patient developed his causal infections but there are equally obscure reasons why he develops a secondary prostatitis, as well as why he so often shows local or general sensitizations to the toxins engendered in them.

Interrelation Between These Foci of Infection.—Tonsillar and dental infections are of such common occurrence that they in themselves offer but slight reason for us to feel that prostatic infections are directly due to them. Particularly is this true when we realize that perhaps at least 35 per cent of all men beyond the age of thirty five years have a prostatic infection. But when we find that at least 90 per cent of these latter have oral infection which is certainly not so predominant in the case in other groups of males of the same age we begin to suspect that there must be some relation between these so widely localized infections. When we see prostatic infection follow acute oral infections this suspicion becomes firmer until our other common clinical observations regarding this close association raises it to the height of conviction though it must be admitted that the whole process is a most unusual one.

Not only is there every reason to believe the prostatic infection is definitely caused by these more distant foci but it is even a matter to prove that the infection in the prostate cannot be permanently so long as these other infections persist. So true is that one is reasonably safe in predicting the presence of infection if by prostatic treatment he is not able to improve the microscopic appearance of the prostatic secretion within six weeks.

specific discharge the day after sexual intercourse, as such discharges often are due to postmenstrual vaginal secretions

Treatment —The treatment of non-specific urethral discharge is so essentially that of the causal factors as largely to direct attention away from the urethra itself, for unless these causes are removed little success can be had by treatment to the urethral mucous membrane. In fact, the discharge usually will stop without treatment to this membrane if the underlying pathology is removed. Thus, prostatic infection should be given its appropriate treatment, strictures should be dilated, urethral cysts or papilloma should be removed by fulguration, a pin-point meatus calls for a meatotomy, balanoposthitis should be cured by cleansing washes, infected teeth should be extracted and infected tonsils should be removed.

The patient who must cohabit with a woman whose postmenstrual secretions irritate should refrain from intercourse for a week after menstruation or use a condom. The patient who has had urethral injections over a great length of time and shows much epithelium in his discharge should have an urethral vacation. The patient with a mucous discharge should be told that it is hypersecretion of a physiological fluid and should be let alone. The patient with a trichomonas infestation should be treated as is advised under that heading.

Chronic urethral discharges almost invariably are due to deeper pathology or stricture and no amount of anterior urethral treatment alone will cure them.

Discharges of short duration in the absence of deeper pathology, usually respond promptly to mild mucosal stimulation. The daily injections of solutions of the strengths advised for gonorrhea generally clear them up within a week. Failure to improve usually means overlooked causal factors.

NON-GONORRHEAL PROSTATITIS

Prostatic infections, other than those due to gonorrhea and tuberculosis, are almost solely secondary to some more distant focus of infection. In at least 95 per cent of the cases these primary foci are either in the dental fossæ or the tonsils. Occasionally the gall-bladder and gastro-intestinal tract seem to be the causal foci. Some few seem to be secondary to an acute infectious disease, notably influenza. Almost never do infections of the facial sinuses seem to play a part.

Just what are the factors at play in the determination of such secondary prostatic infections is not known. In fact, the entire question rests upon clinical experience wherein the association of these infections with prostatic infections is far too constant to be overlooked. Not only are they constant but it requires little observation to reveal that they play an important part in their causation and in their continuance. So true is this that we have given the term "Focal Infective Prostatitis" to them.

That such prostatic infections are not of gonococcal origin is shown by the fact that they occur most commonly in individuals who either

cause acute exacerbations of symptoms in the tissues most highly sensitized to them as well as the generalized symptoms of malaise and a tendency toward temperature imbalance.

It thus is apparent that by digital manipulation of such a prostate we force into the system at large some of the particular toxin to which it is so highly sensitized a point to which we heretofore have given little attention.

The Effects of These Reactions.—As we turn to the effects of these reactions upon the patient we find that they do not differ greatly from those observed in our use of specific vaccines. And while they are of little danger in the milder focal infective conditions, they may be of the gravest importance to those of a more severe nature. In the presence of eye lesions the threshold of ocular toxin tolerance may be so narrow that the reaction may be of a disastrous sort. The same may be true of advanced myocarditis and acute arthritis. In advanced chronic arthritis too severe a reaction is far from pleasant for the patient and is not without hazard. Severe and repeated reactions of the type definitely retard restoration to normal of the distant condition and even slight reactions if often repeated are not to the patient's advantage.

Therapeutic Considerations.—It thus will be seen that the treatment of focal infective prostatitis by prostatic massage in the patient having any distant focal infective manifestation presents considerations that are not of great importance in patients not having such distant symptoms or lesions nor in the presence of postgonorrheal prostatitis. In both of these latter groups such massage may be carried out in a way governed only by the condition of the prostate itself.

In the patient having a distant manifestation of toxic absorption there loom the all-important considerations of toxin dosage and toxin tolerance. And as toxin dosage in this regard is dependent upon the amount of pressure made upon the infected gland it is obvious that in the early stages of treatment at least this consideration is of far more importance to the patient than is the mere matter of promotion of prostatic drainage. For one cannot foretell safely just how sensitive the patient is to the particular toxin nor just how much harm a reaction may do. It therefore is important that the first prostatic manipulations in such patients be of such a gentle nature that they could not possibly cause a severe reaction. Particularly is this so in the presence of severe myocarditis and any ocular lesions. In them no effort should be made to obtain prostatic secretion for study. Even the gentlest prostatic pressure will cause a reaction that leaves little doubt regarding the association of the prostate with the other lesions. The same admonition is not without importance in the severer grades of arthritis for in them a profound reaction often makes the patient definitely worse for days or weeks.

One should not be misled by a small, firm prostate for these are found commonly in patients with deforming arthritis. To the exam-

the other hand, the prostatic secretion is rendered free of pus and the infection recurs, he is at least 90 per cent safe in predicting the finding of further tooth-root infections or pus in the tonsils that have been presumed to be non-infected. So constant are these occurrences as to carry the entire question of their interrelation far beyond the possibility of mere coincidence.

That the facial sinuses play little, if any, part in prostatic infections is shown by the fact that the gland can be carried on to cure despite the persistence of the former, a thing certainly not true of tonsillar, dental, gall-bladder and gastro-intestinal infections that bear a relation to the prostatic focus.

Relation of Distant Focal Infective Lesions.—While it is possibly the case that focal infective prostatitis alone may institute some of the many distant symptoms and lesions that we have come to view as due to toxic absorption from some limited focus of infection, it is probable that they in most cases are not the initial cause. More often these are started by the focus to which the prostatic infection is secondary and the persisting prostatic infection is the reason why the patient does not wholly recover when the other infections are eradicated. That this is the case is shown by the frequency with which such patients become symptom-free so quickly after the institution of prostatic massage. And that the prostatic infection is an important part of the focal infective picture is further shown by the fact that at least 50 per cent of these patients experience an increase in their distant symptoms within twenty-four hours of their first prostatic massage. So constant is this reaction in the presence of massive arthritis and focal infective lesions of the eye that its failure to take place is rather safe evidence that the prostate, though infected, has nothing to do with these distant symptoms or lesions calling for the prostatic study. One can go further than this and say that failure to improve these distant conditions by prostatic massage is either proof that a primary infection elsewhere persists or that the prostatic infection has no causal relation with those conditions.

The Distant Reactions from Prostatic Massage —Reactions caused by digital manipulation of the prostate gland usually occur during the first twelve hours and subside within twenty-four hours. Occasionally they are delayed twenty-four hours and, upon extremely rare occasions, even forty-eight hours. In the presence of advanced arthritic changes, acute arthritis, ocular lesions, such as ulcerative keratitis and iritis, and of myocarditis, the reactions often are severe and long continued, the patient being made definitely worse for days. Occasionally the reaction in other conditions is little more than a feeling of malaise with a slight and brief elevation of temperature. Rarely there may be a chill and temperature reaching even to 104° F.

The Causes of These Reactions —A study of these distant reactions shows them to be analogous with those brought about by the parenteral administration of specific toxins. They show the same tendency to

either type of lesion the expressed fluid should be examined repeatedly by dark-field before surface healing has taken place. The presence of ulceration should be suspected in every patient showing the faintest suggestion of blood in his urethral discharge that is not due to treatment.

Urethrorrhea.—By the term urethrorrhea is meant an appearance at the urinary meatus of normal urethral secretion in the abnormal quantities. It differs from the discharges due to inflammation or cellular desquamation in that it is almost devoid of cellular elements on microscopic study. The discharge is composed of mucus with only an occasional leukocyte or epithelial cell entangled in it. The diagnosis of it, therefore, is only to be made by microscopic study.

This condition gathers its importance from the fact that it so commonly is considered a sign of disease and often is treated for long periods of time under that belief. Its impressive sounding name has been a catchword for the charlatan. With it he has thrown fear into the minds of his victims.

Etiology.—Being due to an increased secretion of urethral mucus the condition may result from any cause that can stimulate such hyperphysiology. It is more common in youth and early adult life. During this period it commonly is due to excess in sexual excitement. Frequent masturbation or prolonged erections of any type favors it. Congestion of the prostate from these or other causes at times occasions such an excessive flow of mucus. It is rather common following chemical treatment to the urethra over long periods of time.

The consumption of alcohol in quantity often is followed in normal individuals by an urethral moisture which at times may be of such a nature as to constitute a true urethrorrhea. Some individuals always have an unusually moist urethral mucous membrane. Their attention seldom is attracted to it until constant urethral stripping after a suspicious sexual contact reveals its presence. Upon rare occasions the condition is due to stricture of large caliber.

Treatment.—Though the condition has no pathological importance it often has a profound psychic one. It rather commonly precipitates the patient into a definite neurosis unless his mind is put at rest regarding it. An effort should be made to determine and remove its cause. If due to sexual excesses the patient should know that he probably cannot get rid of it without correcting his habits. If the habits mean too much to him to be discontinued he should know that the excessive secretion of mucus can do him no possible harm.

In the presence of prostatic congestion this should be corrected by a short course of prostatic massage but even then efforts should be made to remove the causes of the prostatic congestion. When the mucus is due to prolonged urethral treatments they should be discontinued.

Urethrorrhea does not lend itself kindly to cure by either urethral injections or instrumentation. While astringents may for a time check it they are in no sense curative, as the flow usually reappears when they are discontinued. Where there is a history of previous

ming finger they feel as though they could not possibly be playing a part in the focal infective picture. And yet if they are subjected to firm pressure great harm may ensue.

It requires very little experience with prostatic massage in focal infective patients to show that the production of no reaction, or at most, only the slightest reaction is of far greater value from a therapeutic standpoint than is the production of the severer grades.

While the real aim of massage is the promotion of the drainage of purulent products, one does best at times to make this a consideration secondary in importance to that of immunity stimulation or, perhaps, distant tissue desensitization.

The frequency of prostatic massage in these patients in the early stages must be governed by the reactions they occasion. They should not be repeated until at least three days after such a reaction entirely has subsided. In the later stages they should be repeated every three or four days as is the case with postgonorrheal prostatitis.

An abundant experience with autogenous vaccines in the treatment of focal infective prostatitis has convinced the writer that they are prone to prevent cure. This is readily understood when we realize that the digital massage of such glands is in itself a virtual auto-vaccination.

The possibility of recurrent attacks of infection should be borne in mind. Not only should several studies at three months' intervals be made after apparent cure, but repeated roentgenograms of the teeth of those who have had dental abscesses are of equal importance.

As with postgonorrheal prostatitis, it often is wise to give a two months' rest from treatment to those patients whose residual infection remains stationary after three or four months of treatment.

Syphilitic Urethritis.—Chancre of the urethra and meatus occurs with sufficient frequency to warrant consideration. It perhaps is more frequent than is supposed, though the given incidence ranges from 10 to 15 per cent of all genital chancres. To say that chancre should be suspected in all indurated lesions involving the meatus and the distal portion of the urethra is to overlook the fact that chancres rather commonly show no palpable induration. The belief that they do is a heritage of the older clinical days. Our experiences with dark-field studies of the secretions of penile ulcerations have shown us that an enormous proportion of them are not noticeably indurated. In fact, lesions that in the predark-field days would have received no serious attention rather commonly are shown to contain the *Treponema pallidum*.

Thus one should be on the alert, for even the smallest of meatal and urethral ulcerations may be the initial lesions of syphilis. Such ulcerations usually are accompanied by a mucoid urethral discharge which persists despite local treatment. The fear is not that one may be too diligent in his search for these lesions, but that he may view such things so lightly that a dark-field study is not deemed necessary. In the presence of palpable induration suspicion is always aroused. In

CHAPTER VIII

DISEASES OF THE URETHRA IN THE FEMALE

By VINCENT J. O'CONNOR, M.D., F.A.C.S.

IN recent years the female urethra has attracted more clinical consideration than formerly. This added attention has resulted in numerous reports suggesting that this structure is frequently the site of pathological changes which had previously been overlooked. Urinary disturbances are so common in women and with the almost universal increase in detailed study of the entire urinary tract by modern methods, it is to be expected that more precise information has been gained about the frequency of individual lesions and their association with allied conditions in the urinary and generative tracts.

In a study of 1000 women with frequency of urination Bugbee¹ claimed that lesions of the urethra were partially or wholly responsible in 600 instances. Stevens²⁴ in considering 234 consecutive cases of urinary disturbances in women described the urethra as wholly responsible for the symptoms in 56 and partially responsible in 173.

The modern tendency is to consider system pathology by making a careful survey of the entire urinary tract to discover the extent and character of the lesions producing urinary symptoms and dysfunction. Only in this way can proper emphasis, both as to diagnosis and treatment be given to disease of the female urethra. Affections of the cervix uteri, uterus, uterine adnexa, remote foci of infection and even neurological disease must be included in a broad diagnostic consideration.

ANATOMY OF THE FEMALE URETHRA.

The female urethra, unlike that of the male, has a solely urinary function. It is a short wide channel analogous to the membranous portion of the male urethra.

This canal is curved and of cylindrical shape and is about $1\frac{1}{2}$ inches in length extending from the bladder to the vestibule. It courses obliquely downward and forward behind the symphysis pubis and is somewhat concave anteriorly. The external orifice (meatus) is found in varied forms; it is usually shaped like an inverted Y but may appear as a vertical slit or as a dimple or depression in the membranous folds of the vestibule between the clitoris and the vaginal introitus. The orifice constitutes the narrowest portion of the canal and is frequently overlapped by marginal folds of mucosa which conceal the urethral lumen. The urethral wall is made up of a muscular sub-mucous or erectile, and a mucous coat. The epithelium of this lining mucous membrane is of the stratified squamous type, except near the bladder where it takes on the character of the bladder mucosa which is transitional in type. The mucosa is thrown into longitudinal folds

gonococcal infection the caliber of the urethra should be investigated and if narrowings are encountered they should be dilated. If the patient's mind is at rest regarding its significance, no local treatment is needed in most cases. Here, often, Nature is the better doctor.

Prostatorrhea.—Like urethrorrhea, this name is used to signify a hypersecretion which may be due to much the same cause. The prostatic secretion most commonly escapes from the urethra as the result of straining at stool. It is more common in relaxed, poorly-nourished individuals, for which reason it has been a simple matter for the charlatan to use it as a cause instead of a result.

Individuals who have had long courses of prostatic massage for the cure of gonorrheal prostatitis are prone to force out some prostatic secretion at stool. They rarely do so, however, until some months after these treatments have been discontinued. The condition is due more to prostatic relaxation than to the production of an abnormal amount of secretion.

Treatment—The condition can do the patient no possible harm aside from the mental anxiety it causes him. It can be prevented by occasional prostatic massage but shows a tendency to recur when such treatments are stopped unless an effort is made to improve the patient's general muscular tone. Usually Nature will correct matters unaided or it will disappear as the patient resumes his former sexual outlets, be they masturbation or intercourse.

Spermatorrhea—Though of decidedly rare occurrence, this has been one of the charlatans' greatest stocks in trade. He has capitalized it under the heads of "Lost Manhood," "Loss of Vital Fluid," and like captions, and by it has built up a vast following among the neurotically inclined. It has meant millions of dollars to him.

While it is not uncommon to observe a few spermatozoa in the centrifuged sediment of morning samples of urine, it is extremely rare to observe a patient whose urethral discharge is composed of seminal elements. A fair number of patients, however, occasionally force some semen out when straining at stool or to expel the last few drops of urine.

Even true spermatorrhea is a matter of no real moment to the patient, so far as health is concerned. Its only importance is of a psychological nature. It is not an escape of fluid the patient needs and it can continue for years without harm. It has, perhaps, a sexual importance in that such patients court surprise if they consider withdrawal a safe contraceptive measure. Even in patients who do have true spermatorrhea it is rarely a constant condition. There usually are long intervals during which it is absent. Often it only takes place when the patient is run down or tired. Commonly it only follows heavy physical exercise. Local treatment has no influence upon it.

2 **The Involuntary Sphincter of the Bladder (Sphincter Vesicæ)** — What part this muscle plays in closing of the urethra it is difficult to decide. To deny its effect entirely seems unreasonable for three reasons. In the first place it is easy in urethroscopy to convince oneself that the internal urethral orifice closes quite firmly about the instrument. In the second place the non-existence of an anatomically demonstrable orbicular muscle does not necessarily mean that the part in question lacks the power to function as an obturator. In the third place this sphincter is capable of resisting a considerable pressure from the bladder as can be shown by cystography. If the bladder is filled with solution opaque to roentgen rays and the patient is asked to press as if she desired to void a roentgen-ray taken at this time just before the bladder begins to empty shows no indication of the upper urethra becoming filled. Both frontal and lateral views show the clearly demarcated outline of the internal orifice.

3 **The Sphincter Trigonalis.**—The sphincter trigonalis forms a sling shaped loop of fibers in the upper part of the anterior wall of the urethra. According to Halsher¹² these fibers are composed entirely of smooth muscle and extend all the way around to the uterine orifices and into the fundus of the bladder where they become continuous with the muscular coat of the latter.

4 **The External Urethral Sphincter** —The external urethral sphincter is not a sphincter in the true sense. It forms a cuff shaped tunnel opening out backward around the urethra and it is thus more properly named the *compressor urethræ* muscle. As has been stated this structure is chiefly composed of striated muscle enclosed in the urogenital diaphragm. It is perhaps doubtful whether the trigonal and external sphincters can be considered anatomically or functionally as entirely separate entities.

5 **The Hiatus Urogenitalis or External Closing Mechanism.**—The hiatus urogenitalis is the last of the five component parts on which normal continence might be thought to depend. Some observers hold that the muscles and fasciæ surrounding the urethra are mainly instrumental in closing the bladder. One argument in this direction is that the interposition method for restoring continence shows that the closing mechanism of the bladder depends in great measure on the underlying support.

On reviewing all the anatomical considerations however the facts seem to point to the closing mechanism of the female urethra as being located chiefly in a combined action of the urethral muscles themselves.

The bladder is emptied by contraction of the detrusor muscle following relaxation of the urethral and the compressor urethræ muscles (See Chapter on Anatomy and Physiology of Bladder for mechanism of micturition).

The blood supply of the female urethra is from the internal pudic inferior vesical and uterine arteries. The veins drain into the pre-vesical or pudendal plexuses. The lymphatics pass to the nodes of the inguinal region and to the deeper pelvic and hypogastric chain.

by the contraction of the surrounding muscles. In the inner third of the canal the mucosa presents many small tubular glands, while the outer portion contains fewer, more widely scattered larger glands. Just within the external meatus, usually on the floor of the urethra, lie the two openings of Skene's (para-urethral) glands. These ducts may open upon the vestibule outside of the mucous membrane of the urethra. Additional para-urethral ducts and glands may be found about or at some distance from the external urethral orifice and must not be overlooked when searching for infected foci.

The submucosa is a stratum of loose areolar tissue containing elastic fibers and a network of cavernous venous spaces which form a spongy erectile tissue.

The muscular coat, which is continuous with that of the bladder, is composed of an inner non-striated, longitudinal layer and an outer non-striated, circular layer. The outer circular layer is of importance because its upper portion surrounds the vesical outlet to form the involuntary sphincter of the bladder and this muscle, therefore, is really a urethral one which extends into the region underlying the trigone. Both these smooth muscle layers are not voluntarily controllable and receive their innervation from the pelvic ganglia of the sympathetic hypogastric plexus.

Between the two layers of the triangular ligament of the perineum the canal is surrounded by a layer of striated muscle fibers which form the voluntary muscular sphincter (*compressor urethræ*). These striated fibers surround completely only the upper portion of the urethra above the urethro-vaginal septum, where bands interlace both in front of and behind the urethra to form a circular muscle. Some of these fibers extend longitudinally upward beneath the urethra toward the bladder. This striated muscle, *compressor urethræ*, is innervated through branches of the pudic nerve.

Thompson³⁰ has recently made studies of the female urethra with special reference to the closing mechanism of the bladder. He has shown by a series of roentgenograms that the normal urethra has a curious angular profile contrary to the usual anatomical description. With regard to the closing mechanism of the female bladder there has been greatly divided opinion. The proper explanation for this function seems to center about the following points: (1) Tangential relationship of the urethra to the base of the bladder, (2) extent of action of sphincter vesicæ, often called the internal urethral sphincter, (3) sphincter trigonalis, or the intermediate sphincter, (4) activity of external sphincter of urethra, (5) hiatus urogenitalis, or external closing mechanism.

1 The Tangential Relationship of the Urethra to the Base of the Bladder—To the character of this relationship it is hardly possible to ascribe any great importance, inasmuch as it does not exist at all in very young individuals. In the child the bladder is placed at a high level, it is more or less torpedo-shaped and opens perpendicularly into the urinary canal. In the adult it occupies a lower level, and is more rounded toward the cervix, whence the urethra leads off in a tangential direction.

stricture is found it is treated as described later before further examination is made.

Urethroscopic examination is made, in the absence of low-caliber stricture, in the position and with the instrument chosen by the individual examiner. The knee-chest position, using the air urethroscope of Kelly is not a popular method among urologists; it is uncomfortable, fatiguing and often offensive to the patient. To those experienced in the method it may possess advantages, but for the average examiner the dorsal position and some type of irrigating direct or semidirect vision telescopic instrument is recommended. The McCarthy or

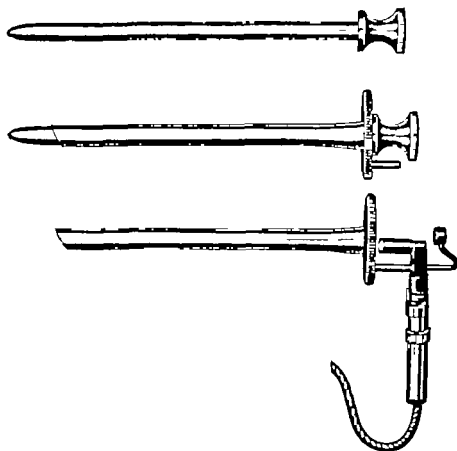


FIG. 186.—Young's urethroscopes and light carrier

Young urethroscopes with the lamp at the distal extremity are very satisfactory for ordinary visualization of the female urethra. Recent valuable additions to more detailed study of the female urethra are the Butterfield female urethroscope and the Dourmashkin* dilator cysto-urethroscope. Water dilating near vision instruments such as the Brown-Buerger universal urethroscope or the McCarthy cysto-urethroscope are most valuable in examining the deeper portion of the urethra coincident with careful cystoscopic examination. Here, as always, the choice of instruments will rest with the individual whose final guide will be experience itself. (Figs. 186, 187, 188 and 189)

EXAMINATION OF THE FEMALE URETHRA.

Preparatory to examination the patient should present herself without voiding urine and without cleansing the vulva by bath or douche for a period of from four to six hours. This allows an inspection of the urethral orifice and para-urethral ducts for purulent discharge which, if present, may be taken upon a platinum or wire loop and smeared over the surface of a clean glass slide and stained by the method desired.

The patient is placed in the dorsal position and the thighs and abdomen draped with clean linen. The labia are best separated at their upper margins with the thumb and index finger of the left hand. The vestibule and meatus are thus brought into clear view and the amount and character of urethral discharge is noted. At this time careful search for vestibular or para-urethral ducts should be made and, if present, gentle pressure applied to express any purulent secretion for microscopic examination. It not infrequently happens that these extra-urethral ducts are infected with gonococci, while the urethra itself is free of infection. At this time the urethral orifice should be thoroughly observed for redness, edema, prolapse of the mucosa and possible presence of caruncle or new growth. The meatus and introitus region should be cleansed with 1 to 2000 bichloride or oxycyanide of mercury solution and dried completely with sterile gauze. Following this the floor of the urethra is carefully palpated with the right index finger and by gently pressing from behind forward any secretion appearing at the meatus may be transferred for examination to glass slides by means of a platinum loop.

The two-glass test is considered a valuable procedure by many urologists. Properly performed, it entails a most thorough cleansing of the vaginal region after a thorough douching of the vagina. The patient then voids urine into two glasses and, if the infection is limited to the urethra, the urine in the first glass will be turbid or contain many gross shreds. The second glass will be clear. The test is fussy and often unsatisfactory because of incomplete vaginal cleansing. A preferable method is to irrigate the urethra repeatedly with warm sterile water or 2 per cent boric acid solution and then insert a small urethral catheter through which the urine may be drawn into a sterile container for analysis and culture.

The anterior third of the urethra may be inspected by eversion of the urethral lips or, if indicated, by means of a skenoscope. This instrument often allows of a more thorough inspection of the para-urethral ducts and in some instances secretion is seen and obtained at the orifices of these ducts when it could not be secured by manual palpation.

The urethral lumen is next calibrated with woven silk-elastic olive-tipped bougies. Isolated stricture occurs at or just inside the external meatus. For this reason woven bougies may buckle and a similar metal instrument is sometimes to be preferred for this procedure. If a

Urethroscopy—Instrumental examination is contraindicated in acute urethral inflammation dense structure or extensive new growth. The female urethra has usually been described as highly sensitive to instrumentation. In my² experience providing the lumen is not contracted the gentle introduction of a urethroscope rarely elicits any complaint from the patient.

Anesthetics to be effective must be applied topically and the usual procedure is to insert cotton applicators soaked in solution within the urethral lumen. This application is frequently more distressing to the patient than the examination itself. Injections of anesthetic solutions through a capillary tube or small catheter give little or no anesthetic effect. In highly nervous women hypodermic injection of morphine and the rectal insertion of cocoa butter suppository containing $\frac{1}{4}$ to $\frac{1}{2}$ grain each of extract of opium and extract of belladonna obviates the necessity of urethral anesthesia. The drugs used by those who favor local anesthesia are novocaine nupercaine metacaine etc. in the strengths advocated for mucosal application. It is most important both for comfort and for thoroughness to have the examination relatively painless and if the examiner can see a possibility of an unfavorable reaction on the part of either urethra or patient a complete anesthesia should be given. Caudal spinal nitrous oxide oxygen and ethylene are preferred in such instances. Gentleness, the right instrument and thorough lubrication make this requirement rarely necessary.

The urethroscope should be introduced into the bladder the urine allowed to escape and with the distending solution running slowly through the tube the inspection begun at the internal vesical orifice. Polypi pedunculated growths and variations in the normal mucosal outline are carefully noted as the instrument is slowly and gently withdrawn over the surface of the urethra. Care must be taken not to overdistend the bladder during the inspection as this frequently causes more discomfort than the inspection of the urethra itself.

Following instrumentation it is well to instill into the bladder from 5 to 10 cc. of mild colloidal silver solution both for the sedative and antiseptic effect.

MALFORMATIONS OF THE FEMALE URETHRA

Congenital defects of the female urethra are much less common than in the male.

Absence—Absence of the urethra is very rarely observed. When this condition occurs there is usually a vesico-vaginal defect associated with other anomalies of the urinary tract such as exstrophy of the bladder or patent urachus. Atresia of the urethra has been reported a few times in association with exstrophy or other bladder anomaly.

Double Urethra.—Cases of complete and incomplete double urethra have been reported. In some cases one canal originated in a congenital bladder diverticulum. Bifurcation or forking of the urethra in which case the single urethral canal arises from the bladder and divides into

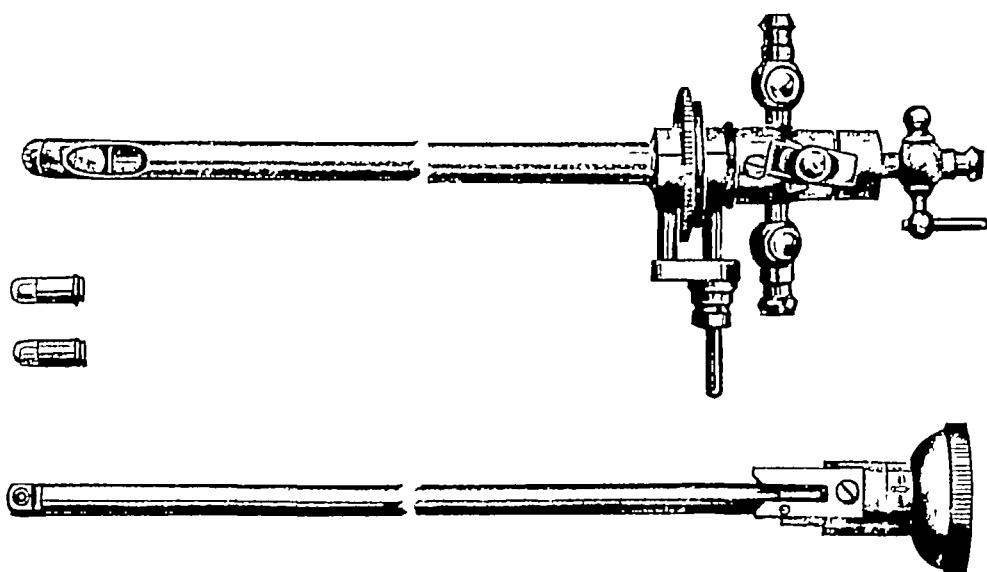


FIG 187 —Buerger's cysto-urethroscope

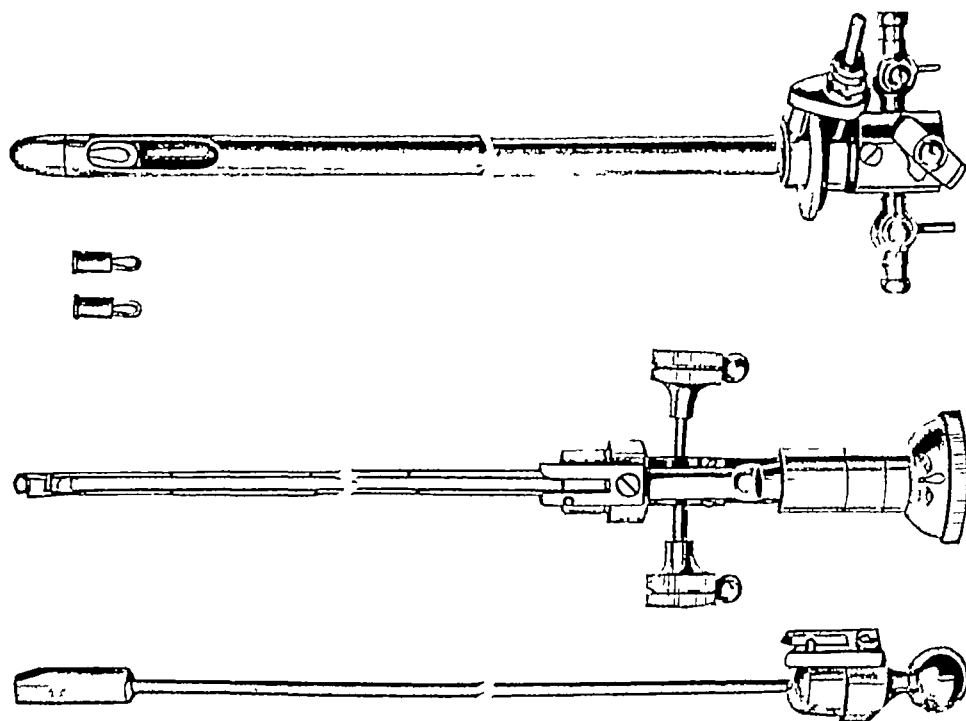


FIG 188 —McCarthy's close vision cysto-urethroscope

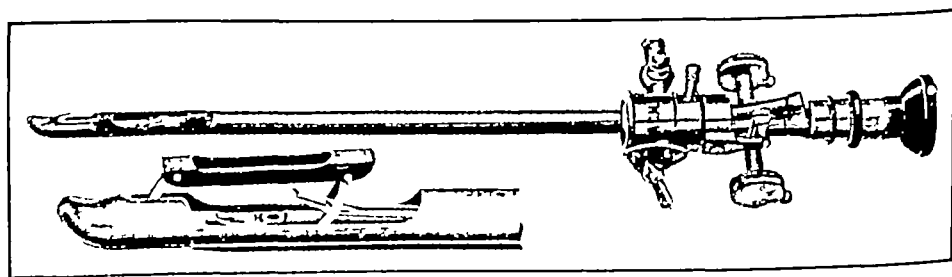


FIG 189 —Dourmashkin dilator cysto-urethroscope for the female

Mercier reviews all operations for epispadias in women under four headings as follows

1 Simple intervention where the object is to narrow the deformed urethra. With this object in view some surgeons among whom is Gersuny have twisted the urethra on its axis after a complete dissection. Others like Hackenbrück have performed the narrowing on the neck of the bladder by setting sutures around it. These procedures have been failures in establishing improved urinary function.

2 The object of these operations have been to elongate the incomplete urethra or to create a new canal. The urethra is formed by a flap fixed in the sulcus dividing the labia majora and the clitoris. This flap in some cases has been taken from the pudic region. Potel obtained his flap from the tissue lying on each side of the furrow. Muratow made the flap from a piece of the hymen. None of these procedures resulted in a complete continence of urine.

3 Operations in this group combine the technique of the preceding two. These have been advocated by Van der Heeven and Nové-Josseland.²² Briefly the procedure is as follows

(a) The urethra is elongated by means of lateral flaps cut on either side of the furrow.

(b) The urethra is narrowed by the excision of a flap on the anterior wall of the vagina near the neck of the bladder.

(c) The operation is completed by the suture of the labia and of the clitoris.

The end results of this group of operations are problematical as regards function.

4 The object of operations in this group is to restore the internal sphincter by transplanting some of the neighboring muscles around the neck of the bladder. Gobell used the pyramidalis muscle on a child aged six years with perfect functional results. Thompson transplanted the rectus abdominalis and cured his patient. Deming sutured around the neck of the bladder a flap of the rectus femoris and obtained complete continence of urine.

Mercier borrowed from all four of the above procedures and drained the bladder by cystotomy for fifteen days. The cystotomy tube was removed on the fifteenth day and at this time a soft rubber catheter was inserted in the urethra for five days, at which time the suprapubic wound was completely healed. A perfect functional result was obtained and the patient voided four to five times a day and never at night. (Figs. 190 to 196.)

Hypospadias.—Hypospadias is a defective development of the external portion of the inferior urethral wall by which the external meatus appears as an oblique opening on the anterior vaginal wall. This condition is a pathological rarity, only about 40 cases being recorded. The position of the urethral meatus may be only slightly behind the normal location or if the entire urethral wall is absent the condition may resemble a vesico-vaginal fistula. As in hypospadias in the male the meatus is frequently constricted and all of the symp-

two canals with separate openings on the vestibule, is more common than two discrete canals. Dannreuther⁶ observed a patient with a complete double urethra with a caruncle at one meatus. Removal of the caruncle relieved the complaint of frequency and burning on urination.

Double urethra must be differentiated from peri-urethral fistulæ which are never congenital and usually the result of peri-urethral infection. The abnormal opening of one ureter upon the vestibule or near the urethra must not be confused with double urethra.

Epispadias.—Epispadias is a congenital deformity of the urethra characterized by partial or complete absence of its superior wall (roof). It is much more rarely found in the female than in the male. In all, about 50 cases have been reported up to 1935.

Duand classifies epispadias in women as occurring in five types. The first, and most simple, is that in which the clitoris is divided in halves and the urethral orifice is merely above its normal level. The second form, subpubic or symphyseal epispadias, presents a defect in the formation of the anterior portion of the urethra. The third is called the total, or retiosymphyseal, epispadias, in which the anterior urethral wall defect extends to the bladder but with an intact sphincter. The fourth form is the subsymphyseal exstrophy in which the sphincter function is lacking but the symphysis is in place. The fifth form is the common form of exstrophy of the bladder, associated with diastasis of the symphysis. Kermauner¹⁷ gives a more simple classification as follows: (1) Partial epispadias, in which the urethra is so constructed that there is partial sphincter control, (2) complete epispadias, where the defect extends into the bladder and there is no sphincter control at all. In the first form the symphysis is normal, in the second, it is separated.

Associated defects, such as division of the vulva, bifid vagina, diastasis recti and inguinal herniæ, are often present with epispadias.

Symptoms.—The symptoms of epispadias are those of partial or complete urinary incontinence with dribbling of urine and irritation of the adjacent skin surfaces.

Treatment.—The simple defect of the external extremity of the superior wall just below the clitoris necessitates no treatment. These cases have no defect of the sphincter and are rarely seen by the surgeon.

Cases of second degree (subpubic) epispadias with no defect of the internal sphincter may demand plastic operation to restore the junction of the labia majora and minora in the median line, and to reform the divided clitoris.

Epispadias complicated by exstrophy of the bladder is a problem of bladder surgery necessitating exclusion of the bladder and urethra and transplantation of the ureters into the sigmoid colon.

The patients having partial or complete incontinence are those who come to the surgeon for relief. Such cases have more recently been reported by Lower,¹⁹ Thompson,³¹ Deming,⁸ Sexton,²⁶ Davis,⁷ and Mercier.²¹

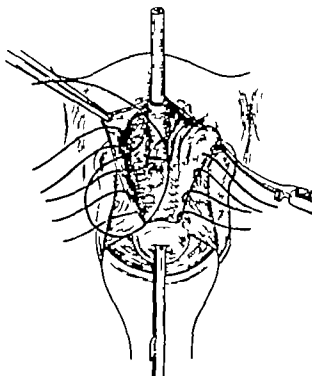


FIG. 194.—Suture of the vesical sphincter in front of the reformed urethra.

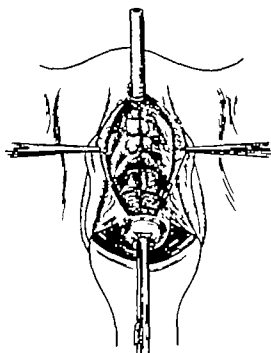


FIG. 195

FIG. 195.—The sphincter is sutured.

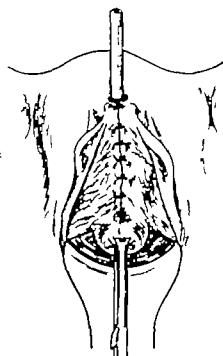


FIG. 196

FIG. 196.—At the end of the operation the catheter is removed

FIGS 199 TO 196 —MERCIER'S OPERATION FOR EPISPADIAS

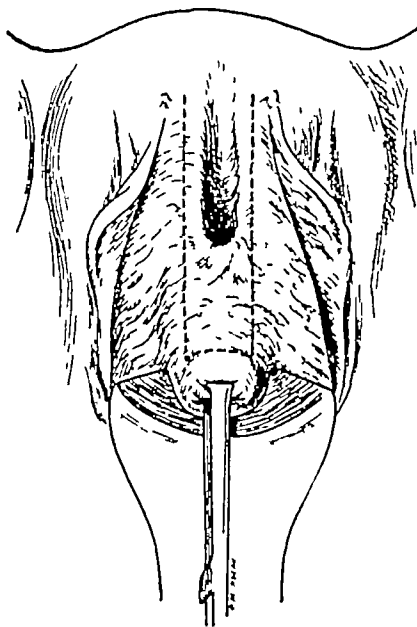


FIG 190

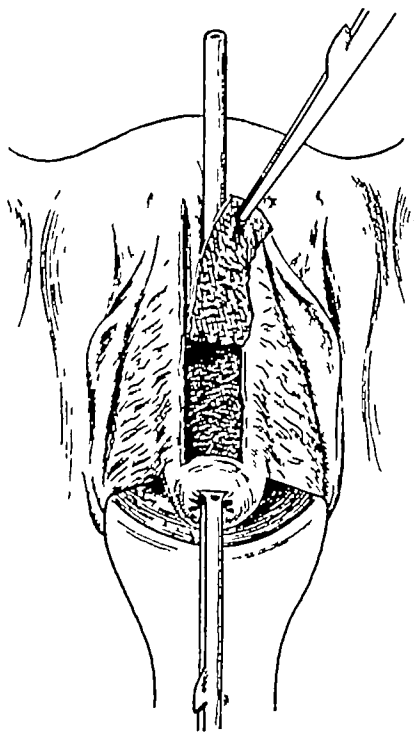


FIG 191

FIG 190 —Outlines of the vaginal flap which is to be used for the reformed urethra

FIG 191 —The vaginal flap is covered and lifted up

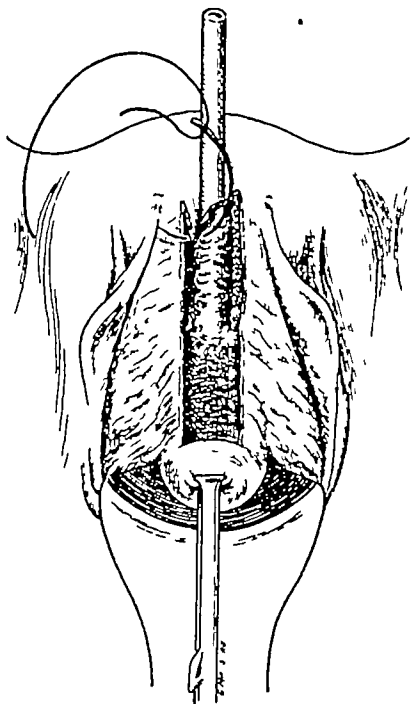


FIG 192

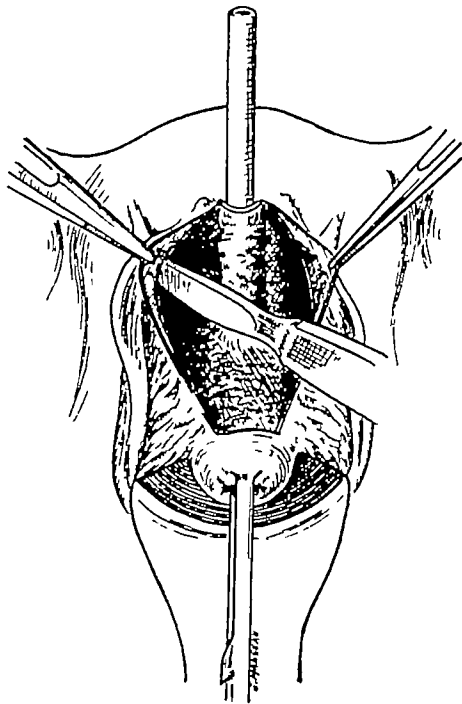


FIG 193

FIG 192 —Suture of the vaginal flap in the frenum

FIG 193 —Lateral dissection for the research of the remains of vesical sphincter

chronic ulceration and infection. In a sense the trauma may surely be considered as an indirect cause of these lesions.

Blows of external violence that cause injury to the female urethra are largely confined to fracture of the pelvis and crushing injuries which tear the urethra or puncture its walls by fragmented spicules of bone. It is a common habit for youngsters to sit on a croquet mallet while waiting turn to play. This is a dangerous practice in that the mallet may break allowing the handle to penetrate the vagina urethra or perineum. I have repaired two such injuries, one of the vagina and urethra and one of the vagina and bladder floor. From personal reports I know of two other such instances, although I have seen no similar references in the literature.

The urethra has occasionally been injured during coitus. In forced intercourse especially in young girls, incontinence may result. I have seen several instances of female urethral injury when the male used some mechanical device as a substitute for a normal erection of the penis. Forceful dilatation of the urethra by an examining finger either purposely or by error in seeking vaginal palpation has been reported as a cause of partial or complete incontinence.

Urethral trauma from catheterization or instrumentation is all too frequent and is inexcusable. It is usually the result of improper training on the part of nurses, interns or even physicians themselves. A proper aseptic technique of catheterization should be thoroughly impressed and reimpresed upon medical students and nurses by a teacher sufficiently experienced to convey the importance of the procedure. The most important requirements are full and complete exposure of the vestibule, thorough cleansing of the entire region, good visual knowledge of the exact location of the meatus, and then gentle passage (slightly upward) of a thoroughly lubricated sterile catheter of proper diameter. Nothing is so objectionable as a nurse or intern attempting to catheterize a patient who is slumped down in bed in such a position that innumerable vaginal jabs are finally followed by the triumphant passage of a catheter, the tip of which has previously entered the vagina or been dragged across the vulva or perineum.

Instrumental injury of the urethra results from too rapid dilatation with sounds, bulbous bougies, urethrosopes, cystoscopes or lithotrites. In several instances I have seen a badly lacerated urethra with permanent sphincter damage from the forcible instrumental extraction of a vesical calculus with cystoscopic rongeur or lithotrite. Overenthusiasm in the use of the Kollmann dilator may injure the urethra. If a blunt nosed straight urethroscope or cystoscope is to be passed the external meatus should always be dilated sufficiently beforehand to insure a painless insertion and a smooth passage of the instrument. A glass or metal catheter may be perfectly safe in the hands of an expert when used by unskilled or careless hands either of them may be most dangerous.

Operative injuries of the female urethra may accompany intentional or unintentional incisions into its wall. Incision of suburethral

toms that are usually associated with urethral stricture may result. Other defects in development of the vagina or vulva have been reported in association with hypospadias. Among these are an unusually large clitoris, a posterior displacement of the vaginal outlet, and the vagina opening into the urethra. In some cases there is almost complete absence of the inferior urethral wall (floor) with lack of sphincter action and resultant incontinence of urine.

Symptoms.—There are no symptoms of this anomaly if the sphincter is active and if the meatus is well forward on the anterior vaginal wall. If the hymen is intact, the urine may flow into the vagina and later dribble from the vaginal outlet. In hypospadias of marked degree there is usually partial or complete incontinence and the skin of the vulva and thighs is often excoriated. In some cases with this defect, in which a very small vagina and the urethra had a common vaginal outlet, “coitus intra-urethram” has been carried on for years.

Treatment.—Dilatation of the orifice by straight metal sounds is the only necessary treatment in the case of stricture of the meatus where no incontinence exists. If the defective urethral wall is associated with partial or complete incontinence of urine, reconstruction by plastic operation is advisable. This is accomplished by bringing together over a catheter two lateral flaps of vaginal mucosa sufficiently long to replace that portion of the urethra that is missing. A sphincter “reefing” operation, similar to that described by Howard A. Kelly, may then restore urinary control.

INJURIES OF THE FEMALE URETHRA.

Injuries of the female urethra may be classified as being due to trauma incident to childbirth, external violence, catheterization and instrumentation, and surgical operations.

The most common injury is that produced in childbirth through compression of the muscular tissue of the urethra between the child's head and the symphysis pubis or between obstetrical forceps and the symphysis. There may be no injury evident at the time of its production and the effects may take months or years to bring about sufficient functional derangement to produce symptoms. Prolonged pressure from the fetal head may result in severe contusion or laceration of the muscle fibers and mucosa. The sequela may be a weakened urethral wall with dilatation of the lumen or, in contrast, there may result a chronic infiltration with fibrosis and stricture formation. The injury to the urethral muscles may result in weakening their contractile power with subsequent partial incontinence of urine. The latter effect may be immediate or long delayed.

It is questionable as to what extent urethral trauma during childbirth may be directly responsible for vascular, lymphatic and mucosal changes later in life. Cystocele with resultant urinary retention, pyelitis and cystitis are often associated with polypi and villous excrescences of the urethral mucosa, trigonal hyperplasia and hyperemia, and

Excision of the redundant mucosa with approximation of the cut edges of the mucosa and the vestibular margin of the urethral opening is usually recommended.

A simple and effective method which we have used since 1918 consists in interlinear coagulation of the prolapsed tissue. Lavermore¹⁸ recommended stellate fulguration' in 1921. Our technique is as follows. Slow bipolar electrocoagulation (diathermy) is accomplished by placing a thin flat electrode $\frac{1}{4}$ inch long and $\frac{1}{8}$ inch wide directly in contact with the prolapsed mucosa. A slow desiccation is preferred as the entire depth of the mucosa should be coagulated. When

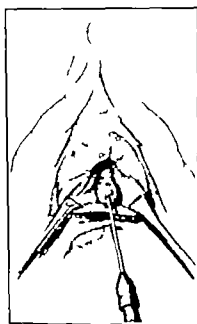


FIG 19

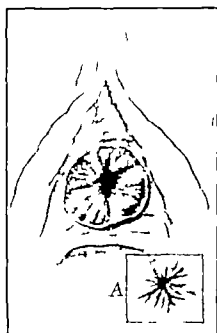


FIG 198

FIG 19. —Method of destroying caruncle of urethra.

FIG 198. —Appearance of urethral prolapse immediately after treatment. A appearance of urethra six weeks after the above treatment. (Corbus and O'Connor)

steaming occurs at the edge of the electrode the current is released. The electrode is then applied to three equidistant portions of the lumen in the same manner. At the time of coagulation no appreciable shrinking of the prolapse is noted. The bulging meatus shows four grayish-white lines of desiccation with prolapsed or normal mucosa between. Sloughing of these areas takes place slowly or not at all. A slow scar tissue formation results which contracts the mucosa symmetrically, literally pulling the meatus and surrounding mucosa inward. If the coagulation has been done transversely with the urethral wall no actual contraction of the lumen results. In 22 patients treated in this manner the results were excellent and there was no stricture formation (Figs. 197 and 198).

abscess of Skene's glands may result in fistula or stricture. In plastic procedures for the relief of cystocele, uterine prolapse, or interposition of the uterus, injury to the urethra must be carefully avoided. Injudicious cauterization of the urethra by chemicals or by the use of the actual cautery or high-frequency currents may result in sloughing and subsequent cicatrization.

Treatment.—The main treatment is preventive and needs no further comment. Urethral laceration associated with fracture of the pelvis or other external violence calls for proper urinary drainage, avoidance of regional infection and preservation or repair of the urethral lumen and musculature.

PROLAPSE OF THE FEMALE URETHRA

Prolapse of the urethra designates an extrusion of the mucous membrane through the external meatus. The condition may be partial or complete but usually the entire circumference of the urethral mucosa protrudes.

Prolapse results from prolonged or repeated straining, such as occurs in tedious labors, difficulty in voiding or in defecation. Vesical calculus, urethritis, urethral calculus, polypi, excessive constipation and prolonged paroxysms of coughing may be mentioned as direct causes. In some instances none of these conditions exist and it is impossible to explain the onset of the prolapse. That this condition occurs at all is probably dependent upon the fact that in some women there is an abnormal redundancy of the mucosa which is not firmly attached to the underlying structures.

Partial prolapse appears as a pedunculated tumor protruding from the meatus and is usually confused with caruncle. Complete prolapse, on first inspection, suggests a tumor at the meatus, but careful examination shows the integrity of the urethral mucosa and its continuity with the mucous membrane covering the vestibule at the meatus. Unless there has been strangulation, the mucosa is red and pouting, but when prolonged venous obstruction has existed, the area is blue and edematous and may even be fissured, ulcerated or necrotic. The area is exquisitely tender and bleeds when touched. Caruncle, polypi, hemorrhoidal condition of the veins of the urethra, new growth and inflammatory swellings of the urethra must be differentiated.

Prolapse is most common in the extremes of life. Keefe¹⁶ reports the age incidence as follows: Under fifteen years of age, 60 per cent, between fifteen and forty years of age, 12 per cent, past forty years of age, 28 per cent.

The subjective symptoms are those of a tender, easily bleeding external meatus and a burning pain on urination which sometimes amounts to a constant desire to void with a feeling of residuum.

Treatment.—Reduction of the mucosa by digital pressure or by means of a soft rubber catheter may be successful if the cause of straining can be removed forthwith. This group includes those with vesical calculus, rectal stricture, cystocele and allied conditions.

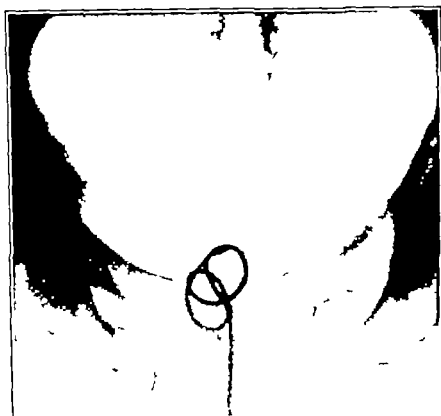


FIG. 199.—Ureteral catheter coiled up in diverticulum of female urethra. (Patient of Dr. R. H. Herbst.)

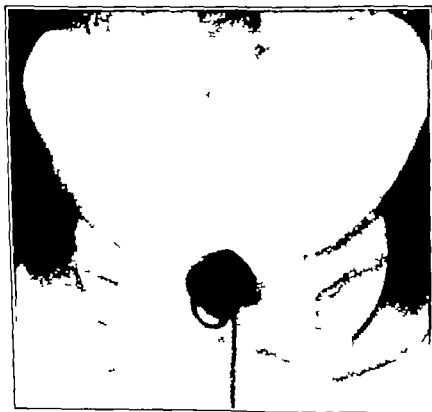


FIG. 200.—Opaque solution outlining diverticulum of female urethra. (Herbst.)

DIVERTICULUM (URETHROCELE) OF THE FEMALE URETHRA

Diverticulum, or urethrocele, is a pouch or sacculation formed by dilatation of a circumscribed portion of the inferior wall of the urethra

Diverticulum of the female urethra may be classified as follows

1 *True Diverticulum* —The protrusion presenting all layers of the urethral wall

2 *False Diverticulum* —In this instance there is a circumscribed dilatation in which the muscularis shows a break in continuity and the protrusion presents only the layers of submucosa and mucosa

3 *Incomplete Urethro-vaginal Fistula* —This condition is, in fact, not a diverticulum at all, since there is a loss of continuity of all the layers of the urethral wall and the pocket ends blindly in the urethro-vaginal septum This condition will be discussed later under sub-urethral abscess

Jarecki¹⁴ uses the term "urine pocket" to designate any of these pouches connected with the urethra Diverticulum occurs most commonly in women who have borne several children and in whom repeated traumatism to the anterior vaginal wall have injured the urethral musculature Inflammatory closure of the urethral gland ducts with resultant retention cysts which suppurate and perforate the urethral wall may give rise to false diverticula Inflammation is continued in the sac by urine being forced in during each micturition

Many writers question the congenital theory of origin Holline regarded his case as definitely one of congenital origin Veit reported a diverticulum with a double orifice leading into the urethra He believed that the origin was congenital and suggested that the diverticulum might have originated from Gartner's ducts Fromme¹¹ reported a patient with a supernumerary ureter opening into a urine pocket He looked on this finding as a proof of Veit's contention that some diverticula of the female urethra were of congenital origin.

The protrusion is commonly seen as a tumefaction upon the anterior vaginal wall, 1 to 3 cm in diameter If the orifice of the diverticulum is large, pressure upon the vaginal aspect gives a sense of a fluctuant cyst and its contents may be easily expressed into the urethra and flow out of the external meatus If the urethral opening is small or obstructed by calcareous material, the tumor feels firm and hard and the content cannot easily be expressed

A probe or small sound may be inserted transurethrally into the sac and felt vaginally Urethroscopic examination may permit vision of the orifice and insertion of an opaque ureteral catheter or the injection of opaque solution for outline of the diverticulum on a roentgenogram Figs 199, 200 and 201 show the value of these procedures

The differential diagnosis includes cysts of the vaginal wall and vesico-vaginal septum, calculus retained in the urethra, and various degrees of cystocele Urethroscopy and urethrography give an exact definition of the condition which is suggested by vaginal inspection and palpation

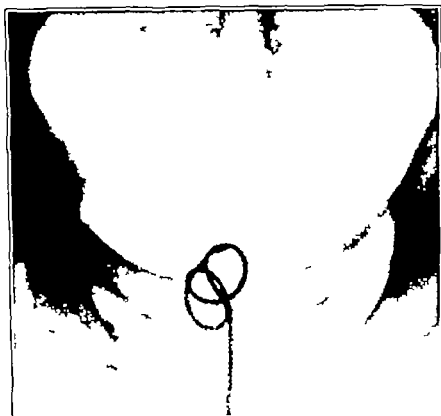


FIG. 100 —Ureteral catheter coiled up in diverticulum of female urethra. (Patient of Dr R. H. Herbst.)

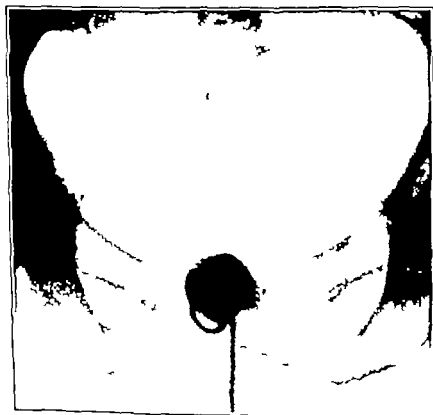


FIG. 200 —Opaque solution outlining diverticulum of female urethra. (Herbst.)

The symptoms are those of painful and frequent urination, pyuria, tenderness in the anterior vaginal wall and a purulent urethral discharge. Dribbling for a sufficient time to empty the sac may follow each urination. The patient may report relief from emptying the sac by digital pressure on the anterior vaginal wall.

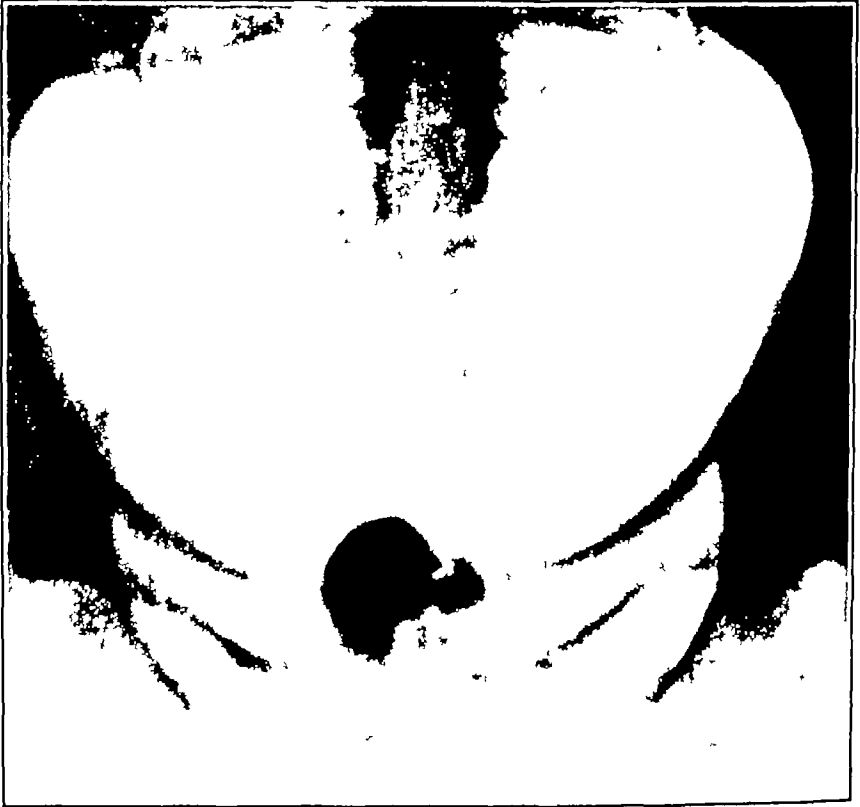


FIG. 201 —Retention in diverticulum after withdrawal of catheter (Herbst)

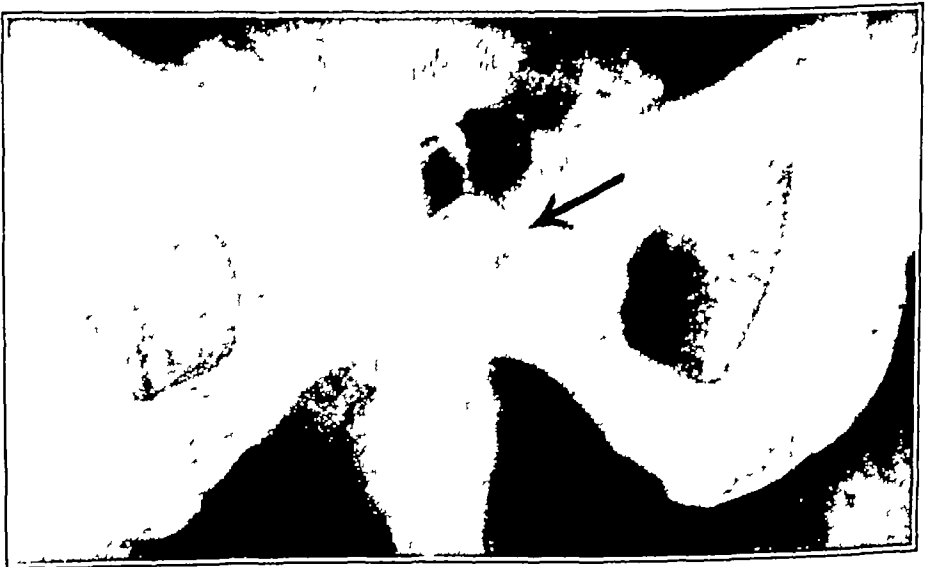


FIG. 202 —Plain roentgenogram showing calculus in urethral diverticulum (Shivers and Cooney)

Calculi in Urethral Diverticula.—Shivers and Cooney²⁷ report an instance of a large calculus in a urethral diverticulum. They collected only 22 such case reports in the literature. Of these, the stone formed around a foreign body in 3 instances. In the cases in which there was no foreign body as a nucleus, all but 2 were instances in which the stone originated above, and during migration became lodged in the urethra.

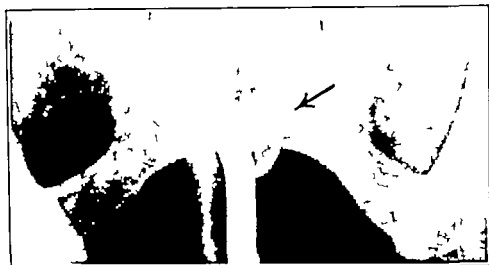


FIG. 203.—Ureteral catheter coiled up in diverticulum containing stone. (Shivers and Cooney.)

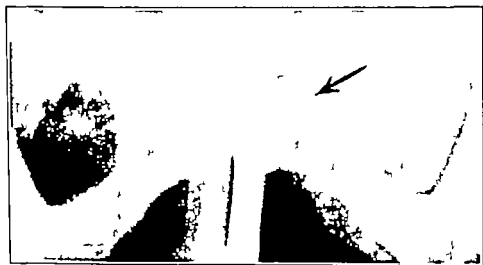


FIG. 204.—Diverticulum containing stone and opaque solution. (Shivers and Cooney.)

subsequently forming a diverticulum. They conclude that including their patient, only 3 authentic cases are on record where a calculus formed primarily in a diverticular sac. (Figs. 202 to 206.)

Treatment.—The ideal method for treatment of urethrocele is the total excision of the entire sac through a vaginal incision. After complete removal the wound is closed by interrupted sutures from side to

side over a catheter or sound and the vaginal layers approximated below. Because of infection in the diverticular sac, healing after excision and suture may be difficult. For this reason Shivers and Cooney recommend diversion of the urine through suprapubic cystostomy for a period of at least eighteen days.

If, after excision and suture, the area breaks down, a urethro-vaginal fistula results. This may subsequently be closed by a simple eversion and suture over an indwelling urethral catheter.



FIG. 205 —Stone removed from diverticulum (Shivers and Cooney)

CALCULUS OF THE FEMALE URETHRA.

Urethral calculus in the female is rare, as compared with the incidence in the male. Most calculi found in the urethra are of renal or vesical origin and have been arrested in the course of their descent. Vesical or renal calculi of considerable size will usually pass naturally from the bladder because the female urethra is short, relatively straight and easily dilatable. Vesical calculi sometimes present prolongations into the urethra. Foreign bodies inserted into the urethra (hairpins, darning needles, chewing gum, etc.) have been caught in the canal and served as a nucleus for stone formation.

Since the external meatus is the narrowest portion of the urethra, the calculus is usually lodged at this point. Impacting is more common in association with stricture.

Symptoms.—The symptoms are those of partial or complete obstruction to urination, frequent and painful urination, pyuria and hematuria.

If the stone cannot be seen after separating the lips of the external meatus, it may be palpated upon a small metal catheter or sound and vaginal palpation at the end of the instrument will reveal the position of the stone. Visualization with the urethroscope is occasionally possible but is rarely necessary to make the diagnosis.

Treatment—As a rule, the calculus may be expressed from the urethra by the fingers in the vagina. Dilatation of the urethra, injection of alcohol or olive oil and extraction of the stone with forceps usually meets with success. An alligator type of forceps is useful in

grasping the stone. If the stone is jagged, too large for easy expression or if there is already marked urethritis with edema it is better to push it back into the bladder. If considerable infection exists an indwelling catheter for a day or two may be followed by the safer procedure of introducing a cystoscopic lithotrite or rongeur and crushing the stone. Traumatism of the urethra especially in the presence of an infected urine is to be avoided. I have repaired the urethra of 2 patients in whom too forceful removal of impacted urethral calculi was followed by urinary incontinence.

URETHRO-VAGINAL FISTULÆ

This type of fistula is rare except in association with extensive vesico-vaginal fistula. Most commonly they are the sequela of peri-urethral abscesses incisions into the urethra division of the urethral lumen or following misdirected high-frequency electrical applications to the urethral mucosa. I have seen two following radium application and three after fulguration. In the latter instances short circuiting of the current was probably responsible for the original urethral burn.

This condition may not be apparent to the patient who notes only a slight dribbling from the vagina after urination. Vaginitis or vulvitis may result. The opening of the fistula is easily seen by speculum inspection of the anterior vaginal wall. It may also be seen but with more difficulty by urethroscopy. If the opening is small it may heal over an indwelling urethral catheter after curettage or the application of silver nitrate. Exposure of the urethra through the vagina freeing the edges of the fistula and closure by purse string over a catheter is usually a simple procedure. Where radium has caused the destruction healing may be difficult or long delayed.

NEOPLASMS OF THE FEMALE URETHRA

New growths of the female urethra arise from the mucous membrane and its blood vessels. They are usually benign in character but are more commonly malignant than was formerly supposed.

Urethral neoplasms may be classified as follows

Benign—Caruncle polypus and papilloma

Malignant—Epithelioma carcinoma adenocarcinoma (rare) and sarcoma (very rare)

Benign Neoplasms of the Female Urethra

Caruncle—The term caruncle as applied to the female urethra includes the various types of mucous polypi which take origin at the meatus. These may arise from a broad base or a slender stalk and usually take origin on the floor of the urethral meatus. Caruncles are usually single but occasionally multiple and as a rule they are very fragile bleeding easily on pressure. They are intensely red in color owing to their extreme vascularity and appear as sessile or pedunculated raspberry-like structures.

Histology.—Histologically caruncles may be divided into two types, papillomatous and angiomatous. The former type is far more common and is covered by stratified squamous or transitional epithelium supported by a connective-tissue framework. The growth usually shows a diffuse inflammation with infiltration of mononuclear or polymorphonuclear leukocytes. The angiomatous type is composed of preponderance of dilated vessels with but a small amount of connective tissue between them.

The type of caruncle which arises as an acute reaction to persistent gonorrheal inflammation of the endocervix and urethra usually subsides with the irritative discharge. Occasionally the condition persists even in the absence of all irritation. Caruncle occurs most frequently in women past middle age, and is commonly seen in very elderly women. In most of these it is rare to get a history of an antecedent venereal disease.

Symptoms —Clinically, a caruncle may be very tender and troublesome or the patient may be totally unaware of its presence. The most frequent symptom is painful urination. This may vary from a mere burning sensation to that of excruciating pain. Coitus may be very painful and followed by profuse bleeding. The tumor may be so tender that walking or sitting is associated with constant localized pain, or there may be no pain at all but frequent attacks of bleeding. This may occur following urination or be entirely dissociated from this function. In some instances one sees an otherwise normal and stable woman converted into a nervous, irritable wreck as the result of a small caruncle. Where pain and bleeding are absent, the condition may be discovered only on urethral or pelvic examination.

Inspection of the protruding polypoid structure at the urinary meatus usually leaves little doubt as to the correct diagnosis. Confusion with various degrees of urethral prolapse may occur, but in prolapse the mucosa is not friable, rarely bleeds easily and can usually be seen as a crescentic ectropion. Carcinoma of the urethra, although a rare condition, may be confused with caruncle and this lesion should always be considered. Ulceration and necrosis of the area should always call for microscopic examination.

Treatment —Unlike most benign tumors, urethral caruncle is prone to recur unless the entire vascular base is removed or destroyed. The mere clipping of its pedicle, as is so frequently done, is usually followed by recurrence. Cauterization with silver nitrate, before or after such a procedure, is likewise unsatisfactory. Two methods of treatment are practised by skilled urologists—surgical resection and electric desiccation (thermoelectric coagulation, not fulguration). Surgical resection must insure complete removal of the caruncle by a circular incision around the meatus, dissecting free the urethral mucous membrane in a way analogous to the Whitehead operation for hemorrhoids. The freed distal portion of the urethra is then excised beyond the point of origin of the caruncle and the base cauterized or the shortened urethra may be sutured to the edge of the circular incision.

One who has attempted surgical excision realizes the degree of bleeding which results and the possible trauma to the urethral wall of hemostats and ligatures. If the urethral floor is too widely excised and suturing is attempted to repair the defect, partial incontinence may result. Crenshaw⁴ has excised many caruncles successfully but does not suture the urethra after resection. He advises searing the base with a solution of mercuric nitrate. Electric desiccation with a needle electrode is a most satisfactory method of destroying caruncles. Fulguration, as used by many is fairly satisfactory but sparking causes carbonization short circuiting of the current around the caruncle and may be ineffective in coagulating the base of the growth. The following technique describes a method of the destruction which makes it a simple procedure for ambulatory patients and is devoid of pain both during and after coagulation.

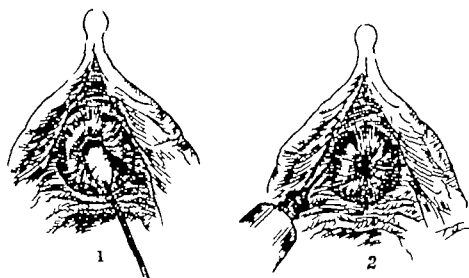


FIG. 200.—Illustrating the method of anesthetizing the region of the female urethra. 1 shows the application of 4 per cent cocaine solution to the urethral mucosa. 2 shows the points of infiltration for securing complete anesthesia in the treatment of urethral prolapse, caruncle and polyp. (Corbus and O'Connor)

The patient is placed in the lithotomy position with the knee-rests widely separated. The vulval folds may be retracted on either side by wide rubber bands which are fastened behind the upper thigh and over the iliac crest in the fashion of a male suspensory. This obviates the necessity of assistants to retract the vulval folds. The labial and urethral regions are cleansed and sterilized. A cotton swab saturated in 1 to 500 nupercaine solution (3 per cent cocaine metacaine, etc. may be used) is introduced into the anterior urethra and retained for five minutes. During the latter period a small amount of 0.5 per cent novocaine solution is injected into the para urethral tissues as shown in Fig. 200. As a rule when the urethral swab is removed excellent anesthesia is obtained for the desiccation of the caruncle despite its size. If the growth is large the urethral mucosa is drawn downward with forceps. If tissue is to be taken for biopsy it is now removed by

a fine wire cutting loop. The needle electrode is then introduced into the base of the caruncle, always being held transversely with the floor of the urethra. A low degree of high-frequency monopolar current is applied and controlled by a foot switch. Carbonization and sparking are to be avoided. A mere desiccation process which destroys the blood supply is most satisfactory and any degree of scar is avoided. There is slight sloughing after eight to ten days and healing is rapidly completed without subsequent recurrence, urethral stricture or distortion.

The additional advantages of this method are its applicability to office patients and the immediate relief of pain. The absence of post-operative pain on urination is notable. If the patient is of a nervous type with an exquisitely tender caruncle, general anesthesia and hospitalization for a day or two should be advised rather than attempting to destroy it under local anesthesia.

Papilloma and Polyp.—Hypertrophied projections from the surface of the mucosa in the form of papilloma or polyp are very commonly observed in all parts of the urethra and are especially to be found about the internal meatus on the margin of or just outside the internal sphincter. These growths are occasionally found near the external meatus.

Etiology.—The cause of polypi or papillomata of the female urethra is often obscure. Kreutzmann believes that these growths are the result of a long-continued irritation to the mucosa, usually bacterial in origin. A history of preceding urethritis is often obtained, but most of the patients give a history of chronic or recurrent pyelocystitis.

In my own experience I have come to feel that whenever I see a diffuse polypoid condition in the female urethra it is absolute evidence of prior or persistent chronic infection in the renal pelvis and bladder. These growths are not seen in association with urinary tuberculosis. Secondary implants of papillary type from renal or vesical papillomata have rarely been observed.

Symptoms.—Observers differ in their interpretation of the part these growths play in the production of symptoms. Since most of these patients have an associated low-grade chronic urinary tract infection causing frequency, urgency and pyuria, and consult the urologist for this reason, the observation of these polypi results during routine diagnostic procedures. In many cases personally observed there have been present multiple rows of long wavy polypi in the posterior urethra when no vesical or urethral distress has ever been felt and the urological condition was one of uninfected renal stones or sterile hydro-nephrosis. In other instances, vesical tenesmus, painful and frequent urination and hematuria seem directly due to the irritation produced locally by these growths. Hematuria, when due to this source, is usually terminal and results from the compression by the sphincter muscles. Visualization of these small tumors is best effected with an open-ended, semidirect or direct instrument (Buerger's cysto-urethroscope, McCarthy's fore oblique cysto-urethroscope and especially well with the recently developed Doumashkin's female urethroscope). When the villous tufts surround the vesical sphincter, they are readily

seen with any of the direct or indirect cystoscope in common use. By revolving the instrument, and examining the region of the sphincter margin while the irrigating fluid washes through the instrument into the urethra the polypi rise and fall into the field of vision. These villi are usually translucent projections with a central single looped blood-vessel which stands out clearly. Occasionally the growths are sessile and contain many vessels which are large in proportion to the size of the growth. (Fig. 207.)

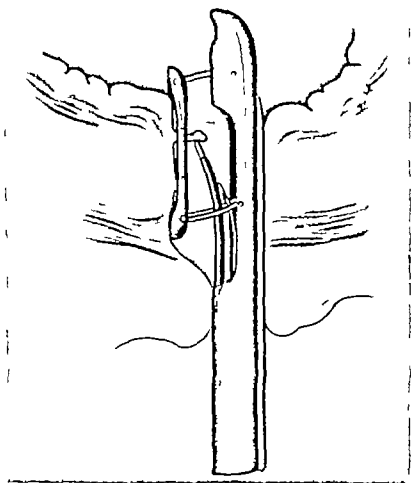


FIG. 207.—Coagulation of urethral polypus through Dourmashkin cysto-urethroscope.

Treatment.—Incomplete destruction as by chemical cauterization, crushing or amputation with scissors is prone to lead to recurrence in a short time though these procedures may be followed by relief of symptoms. The best method is by transinstrumental desiccation or electrocoagulation with the high frequency current. The Oudin (monopolar) or d'Arsonval (bipolar) currents may work equally well. The metal electrode is passed into the base of the growth under direct vision and sufficient coagulation effected to insure destruction of the base. The areas heal in from two to three weeks and on later inspection

a fine wire cutting loop. The needle electrode is then introduced into the base of the caruncle, always being held transversely with the floor of the urethra. A low degree of high-frequency monopolar current is applied and controlled by a foot switch. Carbonization and sparking are to be avoided. A mere desiccation process which destroys the blood supply is most satisfactory and any degree of scar is avoided. There is slight sloughing after eight to ten days and healing is rapidly completed without subsequent recurrence, urethral stricture or distortion.

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Symptoms.—There are no characteristic symptoms of urethral carcinoma except the appearance of the growth itself. Bleeding from the urethra and burning on urination are the common symptoms which prompt the patient to seek advice. Difficulty in urination, pain and frequent urination are sometimes seen.

Diagnosis.—Examination reveals a sessile papillary growth protruding from the meatus or an irregular mass along the urethral wall. The latter may be ulcerated and sloughing or it may be indurated and smooth. Peri-urethral tumors from adenocarcinomata cause a bulging of the urethral floor and may be felt as hard nodular discrete enlargements by palpation of the urethro-vaginal septum.

Differentiation must be made from chronic hyperplastic urethritis, caruncle, polypus and prolapse of the urethra. Carcinoma of the vulva presents a papillary growth with a ragged fungating margin which tends to spread laterally involving the cutaneous surfaces of the vulva and vagina rather than the deeper peri-urethral structures.

Treatment.—Three methods alone or in association are available for the treatment of tumors of the female urethra. Surgical excision, diathermy (deep electrocoagulation) and irradiation by radium or roentgen rays. A combination of operation and irradiation or diathermy and irradiation may be employed.

Because of the lack of sufficient material warranting any one observer in drawing definite conclusions conflicting views are held as to adequate treatment. Counseller and Paterson stated in 1933 that the highest percentage of five-year cures was obtained in cases in which radium and roentgen-rays were used. Yet in a recent report (1935) of a mucoid carcinoma of the urethra Menville and Counseller²⁸ state that the best prognosis is offered in cases where complete surgical extirpation is possible. Crossen⁸ in 1915 collected 26 cases from the literature in which partial or complete resection of the urethra had been done. The results even in cases considered operable were almost uniformly unfavorable. Radical excision of the urethra well beyond the confines of the tumor is advised by Crossen and most writers. Crossen's original suggestion as to technique has been attempted by others with poor results. He advocated the establishment of the vesico-vaginal fistula for urinary drainage while the operative wound is healing, excision of the entire urethra, puckering the vesical neck with a double purse-string suture at the point at which the urethra had been excised from the bladder and then covering the defect of the anterior vaginal wall with flaps of mucosa. Since incontinence is the rule and recurrence frequent in cases so treated it seems best in the light of present-day experience to transplant the ureters to the sigmoid if radical excision of the entire urethra is to be undertaken.

It is frequently stated that roentgen-ray and radium offer the ideal treatment for these growths. Dean at the Memorial Hospital in New York makes this personal contribution: "The disease is still a surgical problem. The growth is radioresistant only intense irra-

show pale, colorless areas of smooth avascular repair. One must never be content to explain a questionable source of hematuria by the finding of the urethral or vesical neck polyp. The bladder must be thoroughly searched for tumor and the upper urinary tract completely studied before placing the blame for the symptoms on these obvious vascular excrescences.

Malignant Neoplasms of the Female Urethra.

Carcinoma.—Up to the present time something less than 150 authentic cases of carcinoma of the female urethra have been reported. From our own experience and some recent reports we believe that, while primary carcinoma of the female urethra is a rare condition, it is nevertheless of considerably more frequent occurrence than one would be led to believe from the scarcity of reports in the literature.

Carcinoma of the urethra should not be confused with carcinoma originating in the vulval or vaginal wall. Many such cases reported as being primarily urethral seem, after careful scrutiny, to be of extra- or peri-urethral origin.

Counseller and Paterson,³ in 1933, found 136 authentic cases of primary carcinoma of the urethra, including 12 instances from the Mayo Clinic. Primary carcinoma of the female urethra most frequently develops in the mucosa of the urethra and is usually of a squamous-cell type, of higher malignancy than is the rule for structurally similar tumors on cutaneous surfaces. It is, more properly speaking, an epithelioma. Urethral adenocarcinoma in the female originates in the peri-urethral glands and is analogous to prostatic carcinoma in the male. These arise most frequently in younger women.

Epithelioma of the female urethra may be of two types: (1) An irregular elongated ulceration involving only the mucous membrane of the floor, usually occurring in the distal segment, and (2) a peri-urethral indurated tumor with a tendency to involve surrounding tissue extensively and occlude the urethral canal. The lymphatic extension from the growths which are primarily in the urethra is upward along the inside of the pubic ramus and into the inguinal nodes. Both superficial and deep lymphatic chains become involved in the extension. In the majority of instances, where the growth is detected early, either there is no extension or only the superficial inguinal glands are involved. In the more advanced cases the superficial subinguinal, the deep femoral and the intrapelvic nodes are involved.

Some of the predisposing factors mentioned are low-grade chronic urethritis, urethral caruncle, malignant degeneration of urethral polyp, local inflammatory processes and various forms of leukoplakia from a prolonged urethritis. Analyzing the case reports from a statistical point of view, it is not apparent that there was a preexisting inflammatory condition of the urethra in many instances.

papillomata of the vulval or labial regions. Specimens for microscopic study are carefully removed with the actual cautery or high frequency cutting loop. Deep slow desiccation with a flat electrode using the bipolar current a high amperage and low voltage is carried out over the entire urethral region until coagulation of the involved areas is completed. A gloved finger should be placed in the vagina and pres-

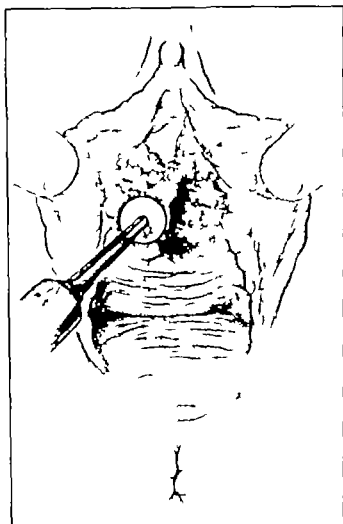


FIG. 209.—Thermocoagulation of carcinomatous area. Active disc-shaped electrode shown in tumor mass partially desiccated. Inactive electrode is beneath the sacral region. (O'Connor)

sure made upward and forward while the tumor mass is being coagulated. The destruction is performed slowly with short intervals between current applications. Carbonization is avoided. Two-thirds of the length of urethra may be coagulated *en bloc* in this manner and urinary function can be maintained because the coagulation can extend to the region of the triangular ligament (0.5 cm. from the vesical orifice) without destroying sphincteric action. Even in hopelessly advanced cases local symptoms are relieved by this procedure.

diation is effective, every urethra treated in this way becomes stricture, and most important is the extreme pain caused by escharotic doses of radium. The results of surgery are none too good but surgery does not add to the patient's suffering." Dean is also quoted by Menville and Counseller as of the opinion that irradiation of the inguinal nodes is of no value because the nodes usually are infected,

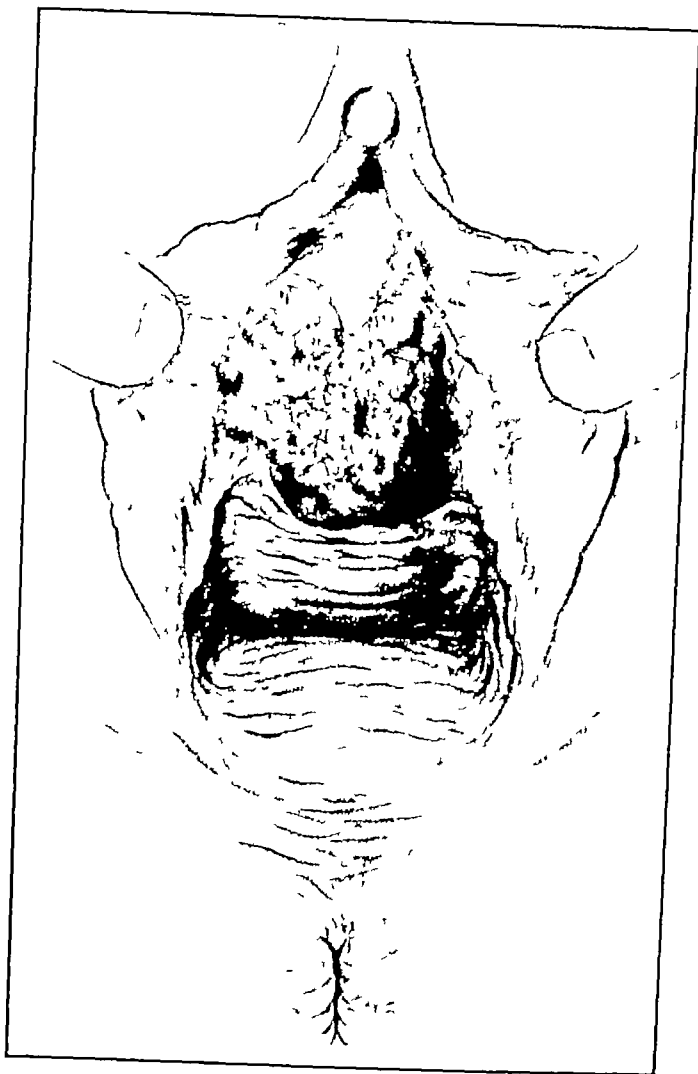


FIG 208 — External appearance of carcinoma primarily involving the urethra (O'Connor)

are surrounded by an abundance of fat, and because the skin will not tolerate a dose sufficient for therapeutic purposes

In extensive growths surgical excision leads to structural mutilation and functional derangement. Radical inguinal dissection to eradicate regional extension is practically always a failure because of the presence of intrapelvic and intra-abdominal metastases

In my experience, diathermy appears the procedure of choice for destroying primary urethral carcinoma, peri-urethral carcinoma and

date for treatment of stricture of the urethra for the rest of her life. The intervals between sounding may eventually be prolonged to six or twelve months.

Rare Tumors of the Urethra

Fibroma of the urethra is extremely rare. Scholl and Braasch²³ describe one case from the Mayo Clinic and cite several others from the literature. Granulomata, varying in size from a cherry to a walnut have been described by Schmidt²⁴ Hertle²⁵ and Hemsius. Menville and Counseller recently reported a mucoid carcinoma which they believe is the first to be recorded.

STRICTURE OF THE URETHRA

Intrinsic stricture of the urethra in the female must be defined as a narrowing of the lumen or meatus by cicatricial contraction of the urethral wall itself. Extrinsic stricture may result from extra urethral pressure due to various pathological causes and does not come under this heading.

Stricture or stenosis of the female urethra may be congenital or acquired. Congenital stenosis is uncommon and when it does occur is frequently associated with other congenital anomalies of the bladder, ureters and kidneys. Female infants so afflicted give early evidence of urinary difficulty and pain on urination with obvious straining on micturition. Occasionally at autopsy one sees instances of female infants with a pin-point external urinary meatus, dilated bladder and ureters and generalized urosepsis. The urologist and pediatrician should cooperate in the diagnosis of difficult voiding as evidenced by these babies. Stricture vesical neck obstruction and spinal disease (especially spina bifida occulta) are the common causes of difficult voiding in these infants.

Acquired strictures are more commonly seen in women after the third decade of life. They are the result of localized inflammatory processes or of traumata.

Inflammatory strictures occur most frequently at the meatus or in that part of the urethra adjacent to the para urethral glands (Skene's). The most common etiological factors are gonorrhea and ulceration from syphilis, chancroids and tuberculosis. The latter cause is probably most rare as extensive tuberculosis frequently causes a sclerotic fixation of bladder and urethra with lack of sphincteric action and incontinence. In the author's opinion a more common factor than any other except gonorrhea is urethritis of non-specific origin with para-urethritis and ultimate sclerosis.

Traumatic strictures are found both at the external meatus and in the lumen of the canal. The cicatricial narrowings in these cases are the result of traumatism occurring during childbirth or surgical procedures. Fulguration chemical cauterization and irradiation may produce stricture.

An indwelling catheter should be maintained for from five to seven days after coagulation. It should be emphasized that for several months (sometimes for years) after the coagulation of these tumors

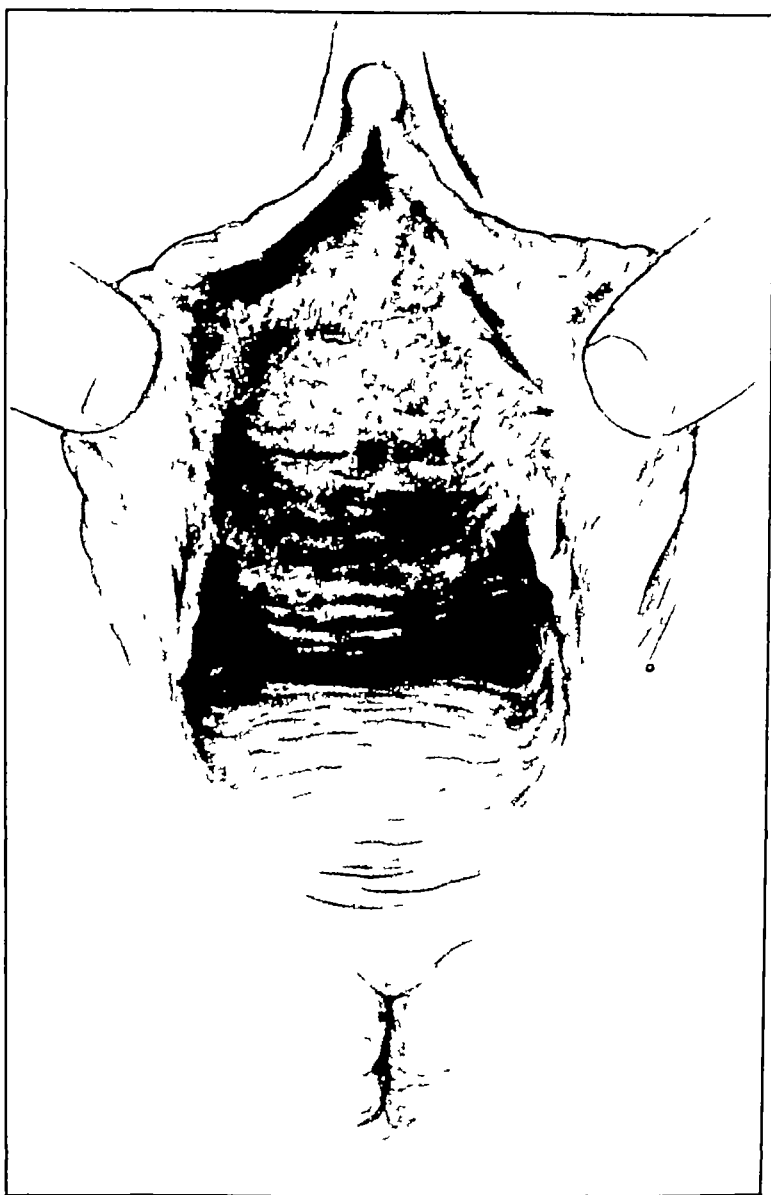


FIG 210 —Shows urethral region as seen six months after destruction of tumor by diathermy. The entire region is completely healed and there is no evidence of local recurrence. The urethral canal is only 0.5 cm. in length, but entire sphincter control is maintained. (O'Connor)

the patient must present herself for the passage of sounds to prevent stricture and contraction of the urethral lumen. (Figs 208, 209 and 210)

Occasionally radium seems effective in these cases, and here again the patient, if she has no recurrence of the original growth, is a candi-

but the straight tapered metal sound is preferred to the Van Buren or Chierre-Benique instruments commonly used in the male. The Walther catheter (Fig. 211) sound is ideal for this purpose as it has a tapered tip and a slight upward curve corresponding to the normal course of the urethra. Instillation of medication may be made through it thus avoiding the necessity of a second catheterization. The straight Kollmann dilator is used by many to dilate the female urethra. If handled with great care it may be a useful instrument. However there is a great temptation toward too forceful a dilatation which may be attended by an unnecessary and harmful reaction.

For gradual progressive dilatation the intervals between treatments should usually be from four to seven days. The sounds are increased in diameter by 0.33 mm (1 F) on each successive treatment. Bladder instillation of colloidal or inorganic silver salt solutions should as a rule, follow the dilatation.

In the presence of dense infiltrations which are relatively resistant to repeated dilatation many urologists advise cutting through the strictured area either by internal or external urethrotomy. I have

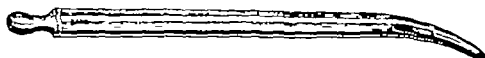


FIG. 211.—Walther catheter sound for treating stricture of the female urethra.

seen these procedures used in only a few instances and have seen no benefit which would not have resulted if patient progressive dilatation alone had been used.

I believe these procedures (internal and external urethrotomy in women) are the type which are always advised in textbooks but which are rarely if ever practised by their sponsors. The scar which results after surgical incision or excision of a urethral stricture in the female is often an added burden rather than a help in the continued sound dilatation which is always necessary anyway.

Riba has recently devised a bougie with high frequency wire incisor attachment which should be utilized by anyone who feels that the process of dilatation can or should be hurried up by other than progressive stretching of the lumen.

INFLAMMATIONS OF THE FEMALE URETHRA.

The importance and frequent occurrence of infection of the female urethra has not been sufficiently impressed upon the medical profession. Some of the reasons for this ignorance are to be found in the total absence of this subject in the undergraduate instruction in many of our medical schools and in the brief and inadequate discussion of it in most standard text books.

Acute generalized purulent urethritis in the female is usually due to infection with the diplococcus of Neisser (gonococcus).

The frequency of urethral stricture in women is a mooted point among urologists and gynecologists. The latter, in the main, insist that it is of rare occurrence. Hunner, an exception, believes it to be of very frequent occurrence. Stevens,²⁹ Folsom,¹⁰ and Walther³² have all repeatedly reported in recent years that stricture of the urethra in women is a most frequent lesion. Stevens states that in his series of patients with ureteral stricture, urethral strictures were present in 54.5 per cent. He also found in examining 169 women with urinary symptoms that urethral stricture was present in 55.4 per cent. Other observers believe that urethral stricture in women is of infrequent occurrence, although there has been a definite tendency for almost all urologists to admit that such lesions are distinctly more common and of more importance than was previously supposed.

Symptoms.—Frequency of urination is the most common symptom. Pain on urination may be localized in the urethra or may be referred to the bladder, sacral, inguinal or lumbar region. Urgency, difficult micturition, small stream, sense of residuum after voiding, partial incontinence or dribbling may all be associated symptoms. Since many of the patients seen have an associated urethritis or cystitis, the symptoms in general are those of urinary tract infection.

Diagnosis.—The diagnosis of urethral stricture is made by calibration of the urethral lumen. Olive-tipped bougies (*bougie a boule*) are preferable to any other type of calibrator. Normally the adult female urethra admits without "hang" a 24 F bulb. Sounds or tapered calibrators do not give accurate evidence of the size of the urethral lumen. Stricture at the meatus is observed on external examination. Diffuse sclerotic stricture with infiltration of the outer third of the urethra may be felt as a rope-like area through the anterior vaginal wall. The urethroscope has been advised in an effort to diagnose strictures. Since most strictures are near the meatus, the introduction of the instrument is often either impossible or produces a traumatic division that obscures the true extent of the contraction.

The urine may be sterile and essentially normal or it may contain all the products of urinary infection, depending upon the associated pathology. Stricture of the urethra is often noted in association with interstitial cystitis and the urine obtained is normal on analysis and culture. In elderly women with a senile atrophy of the vulva there may result a marked contraction in the diameter of the external meatus.

Treatment.—Gentle dilatation of the urethra by the passage of progressively larger sounds is the method of choice. The reabsorption, or softening, of the cicatrix will depend upon its vascularity and the extent of fibrotic replacement in the urethral wall. Some scars soften quickly and more or less permanently after a few dilatations. Others are very resistant and have to be widely dilated to effect a normal-sized lumen. Even then these areas may recontract quickly. Too rapid dilatation with its associated trauma may do more eventual harm than good. Any sound may be used for dilating the urethra,

abnormal acidity due to obscure metabolic processes have all been put forward as an explanation of this condition.

The condition may well be compared with the prostatic infections of obscure etiology of which the symptoms signs course, duration and treatment correspond.

In these cases the colon bacillus is most commonly found in the urine and in pus obtained from the urethra and in many cases a history of intestinal disturbance preceding or coincident with the urethral and vesical symptoms is elicited. Staphylococci and streptococci are also commonly found in this so-called simple urethritis.

The striking frequency of this urethral and vesical condition in association with tonsillitis and grippe has been repeatedly observed. Hunner has called attention to the association of urethral and pharyngeal conditions and the literature is now voluminous concerning the relations between or the coincidental abnormalities of certain nasal structures and the urethra and genital organs. In many of these cases symptoms of acute urethral inflammation have been present.

Treatment of Acute Non-gonococcal Urethritis.—The removal of the cause of the inflammation is the chief indication and no further treatment is usually called for. The calculus foreign body or catheter must be eliminated. Catheterization must be stopped or interrupted for a period when this is possible. The technique of catheterization should be carefully studied and errors corrected.

Injections of argyrol may aid in hastening the subsidence of discharge and relieve discomfort yet these medicaments are usually unnecessary unless the symptoms persist for three or more days after removal of the cause.

Prophylactic treatment against the chronic urethritis which commonly follows this simple acute urethritis consists in the early recognition of its existence the correction of the causative factors and local urethral treatment by means of injections (silver salts zinc sulphate etc.) or through the urethroscope (at a later period not during the acute stage) if the subjective or objective symptoms persist.

Gonococcal Urethritis.—Gonococcal urethritis in the female may occasion such slight discomfort and be of such short duration that the patient finds no occasion for recourse to the physician. She may have no discomfort in the urethra and no disturbance of urination—no subjective indication. The fear of detection even in aggravated cases commonly induces her to conceal what evidence she has discovered during the short time the symptoms are present.

The male practically always knows that he has acquired an infection while the female rarely does.

While one should carefully guard against the indictment of a woman presenting a history of urethral irritability and purulent discharge or of any case with acute subacute or chronic urethritis as of gonococcal origin it may be presumed that a girl or woman exposed to infection of gonorrhea with the history of symptoms of urethritis supervening has had gonorrheal urethritis.

The diagnosis of one variety of acute urethritis from another depends upon the demonstration of the bacterial growth found in the exudate. No case of acute urethritis can be called gonorrheal until positive and authoritative demonstration of the gonococcus in the exudate has been made. It is unscientific and morally wrong to fail to prove by the best bacteriological evidence the character of the germ present in any case of urethritis. The Gram stain should always be used in searching for the gonococcus.

Acute Simple (Non-gonococcic) Urethritis.—Acute purulent inflammation of the entire urethra due to infection by organisms other than the gonococcus is seen in prolonged irritation of the mucosa by a catheter retained in the canal for drainage of the bladder and in the presence of other foreign bodies (calculus, inserted objects, such as pins, hair-pins, etc.) and after repeated traumatisms or irritations, such as the frequent use of the catheter or overzealous exploration and treatment.

Infection of the urethra by unclean, rough or frequently repeated catheterization is probably very often the condition commonly and improperly called cystitis. This does not imply that infection of the bladder (cystitis) is uncommon through catheter infection, but it does imply that the bladder is carelessly regarded as the seat of an inflammation or lesion which can be shown to lie in the urethra in many cases. In many of such cases the cystoscope shows normal conditions within the bladder.

Acute inflammation of the urethra of non-gonococcic origin is a condition of far greater consequence than is usually accorded to it, because of the rapid disappearance of all gross manifestations of its presence through simply removing the cause (*i. e.*, removal of foreign body, cessation of catheterization, etc.), and the improvement in the subjective symptoms. This form of urethritis is regarded as of little consequence just because these signs and symptoms can so readily be explained and so obviously and promptly relieved. Complete cure, however, does not always follow this manifest improvement. In the majority of cases, to be sure, there is no persistence or recurrence of symptoms or signs and a cure does take place. In many cases, on the other hand (and every surgeon can recall such), there is a persistence of the subjective complaints or a recurrence of them after a time. The urine then may present no pathological elements, complete examination of the urinary tract (excepting the urethra) shows no renal, ureteral or vesical abnormality and gynecological examination affords no evidence of the cause. When an examination of the urethra is made, and the lesions of chronic urethritis are revealed, a history of catheter infection (cystitis?) is often recalled.

An acute inflammation of the urethra often accompanied with involvement of the contiguous bladder mucous membrane (cysto-urethritis, trigonitis, cervico-urethritis so-called) is a common condition, the etiology of which is obscure. Among the laity this is the well-recognized "cold in the bladder." Exposure to cold, errors in diet, alcoholic excess, chemical alteration of the urine other than

Pyuria Without Urethral Discharge—That acute purulent lesions persist in the urethra giving pyuria without discharge of pus from the external meatus and with normal bladder and normal kidneys there is little question. An ulceration or persistent infection at the vesico-urethral junction or in the urethra just outside the internal sphincter has been observed which produced a surprising amount of purulent secretion that passed back into the bladder making the urine densely turbid. Secretion from this lesion does not find its way through the external voluntary sphincter but like that of purulent prostatitis in the male does escape through the internal sphincter into the bladder. Treatment of the bladder in such cases accomplished nothing and is wasteful of time and effort while direct treatment of the urethral lesion is the only means of relief.

Examination for Gonococcal Infection.—The following plan should be followed when the female urethra is to be examined for the detection of the diplococcus of Neisser and the same principles apply for examination of the cervix glands of Bartholin and vagina all of which should usually be examined at the same visit.

The patient must take no douche or bath and must not wash the vulva for twelve hours preceding the examination. She should not void the urine for at least three hours and it is preferable that twelve hours elapse preceding the examination. It is often well to instruct the patient to come for examination early in the morning without voiding urine since retiring the night before.

No washing of the vulva by a nurse should be permitted when the patient is prepared for examination.

The labia are separated and specimens of any secretion are taken up with a platinum loop or thoroughly sterilized cotton swabs and spread upon glass slides labeled according to the site where secretion is found. Thus often one set of three to six slides is labeled labia minora another set vestibule and still others, external meatus vaginal orifice vagina right Bartholin cervix etc. Thus it may readily be seen, promises labor for the laboratory but that is what the laboratory is for and the duty of the conscientious examiner demands at least that the work be thoroughly done.

Secretion obtainable at the external urethral orifice must be separately collected to differentiate it from that obtained from within the urethra. The urethra may be free of infection while its outlet is bathed in pus from the vagina or from an infected para-urethral duct which may open outside the canal.

The urethral meatus is then opened by separating its margins with the fingers and the vestibule and orifice are washed with cotton sponges wet with salt solution and then dried with sterile gauze. The platinum loop (fired and cooled) or a sterile cotton swab on an applicator is inserted into the canal 0.5 cm. and withdrawn and the secretion upon it spread immediately upon slides. This may be repeated several times to obtain a sufficient number of specimens for careful search. It can be done painlessly and without trauma.

Upon this presumption only rests, in many cases, the ascribing of the lesions of chronic urethritis, suburethral abscess, infection of para-urethral ducts without demonstration of the gonococcus to an antecedent gonococcic infection, and upon this frequently justified presumption many cases are explained.

A woman may have, in fact, commonly does have, an acute gonococcic urethritis without realizing that she is the victim of any pathological process, wherefore her history is not a factor comparable with the search for the pathological evidence and the bacterium. She asserts and believes that there is "nothing the matter with her," and only by the most painstaking scientific search, in which asepsis, excellent clinical and laboratory technique, wide experience with microscope and complete knowledge of the pathology of the disease plays each its important part, can the proof or satisfactory evidence of the nature of the lesion be determined.

Women who present themselves to a practitioner for a certificate of freedom from gonococcic infection are commonly subjected to examination by inspection, palpation and urinary examination. These means are quite inadequate for the discovery of nearly all cases except the acute and florid. Most subsiding and chronic cases are not revealed by such superficial studies which, so far as they go, give normal signs only, and the proof of the disease is overlooked. The failure of medical examination of prostitutes to reveal gonococcic infectiousness is due to the very deceptive hiding of the bacterium in folds of the mucosa or beneath the epithelium in ducts and glands.

Gonococci beneath the epithelium actively promoting a small focus of infection are not discoverable by any means. It is only when they come upon the surface or can be brought to the surface that they can be obtained for examination. This is one of the reasons why a single examination is never adequate to form the basis for the opinion that a urethral mucous membrane is not infectious. Several examinations under the most favorable circumstances for finding the bacteria and the most careful observation over a long period of time with complete cooperation on the part of the patient are always necessary before the opinion of non-infectiousness can be honestly and fairly given in any suspicious case.

Lack of cooperation on the part of the patient, who may be very fully informed, will nullify the value of findings in markedly infectious cases of urethritis. Simply by passing through the urethra a small part of the urine just before the examination, all evidence of the presence of pus and bacteria can be washed away. The urine obtained in the examiner's office is then normal, and of urethral secretion is none.

In such cases the acute condition has disappeared from the greater part of the mucosa, but is persistent in one or more localized, perhaps minute, areas where redness, swelling and hypersensibility may still be found by means of the urethroscope or skenoscope.

bacterium from an infected source to the more delicate and more susceptible mucous membrane of the vulva of the infant or young girl is common through contaminated objects such as clinical thermometers, diapers, towels, toilet seats, the hands of attendants and nurses.

The little girl who sleeps in bed with an infected individual may acquire this infection from secretion deposited upon the bedclothes or through handling by infection-carrying hands. This source of infection is common among the poorer classes who visit our free clinics, and is not uncommon among all classes. In children the urethra is readily infected but is rarely the site of a persistent and chronic lesion. Long-continued vulvo-vaginitis in children is usually due to chronic infection in the cervix uteri. Repeated reinfections of the urethra from this source may occur.

Acute gonococcic urethritis in the female is usually a short-lived process, lasting from three or four days to three weeks in untreated cases. The acute symptoms consist in itching or burning in the urethra, with a scalding sensation during urination, frequent desire for micturition, more or less urethral discharge of pus containing gonococci, and occasionally some blood or terminal hematuria. These symptoms last for a few days and arouse often slight attention on the part of the victim so that she does not consult a physician. When the pain is great or frequent imperative calls for urination with strangury arise, or the discharge is florid and she is unaccustomed to vaginal discharge or blood is observed at a time apart from a menstrual period, any of these conditions may lead her to seek medical examination for relief. It is however to be remembered that a woman will usually patiently bear the above-mentioned discomforts in the hope that they will soon pass away and she commonly ascribes them to some indiscretion in diet. Her hope is often fulfilled and she believes herself unaffected by any serious condition because of the subsidence of all subjective symptoms after a few days. On the other hand symptoms may be aggravated and prolonged and the victim may immediately seek medical advice.

On examination in the acute case the external meatus is dark red and swollen with discharge flowing from it or readily expressed by the slightest pressure. The vestibule, meatus, and urethra *per vaginam* are exquisitely tender to touch. The secretion transferred to a microscopic slide shows pus with the characteristic biscuit-shaped extracellular and intracellular diplococci which are negative to the Gram stain and cultures from this secretion grow the characteristic colonies of this organism on suitable media. The orifices of Skene's ducts may stand out as pouting red points when exposed just within the meatus. Pressure upon these ducts through the vestibule or through the vagina shows a drop of pus at the orifice and palpation of the urethra *per vaginam* gives pain, causes an increase of the discharge at the meatus and the normal cord-like feeling of the urethra above the vagina is changed by the soft thickening of its walls due to the inflammatory infiltration. If gonococci are not found in the secretion

No vaginal examination by means of the fingers or speculum should be made until these specimens from the urethral orifice and canal have been secured

Now the hairpin retractor of Kelly or a bent probe or the skenoscope is inserted into the urethral meatus to expose the orifice of one and then the other of Skene's ducts while pressure is made below the floor of the anterior part of the urethra against the vestibule or upon the anterior wall of the vagina, close to the vaginal outlet, and the secretion expressed from the duct taken up and preserved on specially labeled slides (left, Skene, right, Skene, etc.)

The whole urethra is then stroked from the bladder to the external meatus (from behind, forward) through the anterior vaginal wall. This can often be done in infants without strain or rupture of the hymen

Several specimens of all secretion thus obtained must be preserved upon labeled slides

If search is to be made (as must commonly be the case) in the vagina, cervix, vulvo-vaginal glands, etc., this should next be carried out

The vagina is then cleansed by douche or by sponges on sponge holders and mopped dry with gauze or cotton, and the vulva is washed with boric acid solution and dried with gauze

The patient is then instructed to urinate into two sterile beakers—a small portion, or the first gush of urine, in one, and the remainder of the bladder contents into the other. All of the urine in glass No. 1 should be centrifugalized and the sediment thoroughly searched for pus and for bacteria, and cultures should be made from this sediment under laboratory precautions

The patient again takes her place on the table and a critical examination of the entire urethral mucosa is made with the urethroscope, through which all adherent mucus and pus upon the walls is secured for bacteriological examination, and lesions are carefully noted

No case of suspected gonorrheal infection of the urethra has had a thorough or adequate examination unless a routine as complete as this had been followed, and no case can be declared free of gonorrheal infection unless repeated complete tests of this sort are carried out after stimulation of the urethra and para-urethral ducts with silver nitrate or other irritant directly applied. The doubtful expedient of the ingestion of alcoholic beverage to irritate this part of the urinary tract may aid in promoting the appearance of discharge, which is to be searched for the offending organism

Acute Gonococcus Urethritis—This is an acute exudative inflammation of the mucous membrane involving the entire extent of the canal, due to lodgment and growth upon and in the mucosa of the gonococcus or diplococcus of Neisser

It is acquired by adults almost exclusively during coitus, although the bacteria may be transferred through freshly soiled objects, such as douche nozzle, towels, toilet seats, etc. Infection except through sexual contact is very rare in adults, while the transference of the

external meatus. These infected areas are the lesions which persist as chronic foci of inflammation.

In this subsiding stage the woman may consider herself well even if she has recognized during the florid stage that a definite disease process has been present yet the secretion from the urethra is highly infectious.

When the active process has subsided there persists for a short or long time the stages described as subacute and chronic.

The subacute stage is merely a continuance of the subsiding acute process. It is an indefinable period during which very slight subjective and objective symptoms and signs remain. It may be said to have a duration of from two to five weeks.

It is well known and has been stated above that acute gonococcal urethritis in the female usually subsides in less than ten days to a subacute condition of relative comfort and one in which the objective signs are scarcely manifest. This subacute stage has a duration of from ten days to five weeks. Urethritis persisting longer than five weeks may be called chronic.

The pathological condition has during the first two to ten days been an active acute exudate inflammation of the entire mucous membrane. The entire inner membrane (epithelium) is, during this stage, swollen, deep red in color and covered with yellow fluid pus. The blood vessels are dilated, leukocytes are packed into the submucous and mucous layers and escape upon the surface which is secreting an abnormal quantity of mucus and the epithelium is desquamated as individual cells or in plaques or groups of cells. Minute hemorrhages take place into the mucosa and upon its surface. The gonococci are to be found in the epithelial cells and penetrating between cells in the mucous and submucous layers, and within the leukocytes.

Wherever crypts, lacunae, folds or glands exist the inflammatory process extends into the depths, and gonococci penetrate into the lower most recesses and out into the surrounding tissues about such crypts and glands. Minute abscesses are thus formed which bottle-like, may be shut off from the canal through adhesion or occlusion of their outlets to open again as the inflammation surrounding them subsides, with discharge of the infectious contents into the main channel of the urethra giving rise to recrudescence or recurrence of the diffuse inflammation through the canal. These pockets of infection in glands, crypts, and sulci are the sites of long persisting lesions often microscopic in size but large in their potency for recurrent or chronic infection. Some minute lesions may extend to coalesce to form gross areas of suppuration called suburethral and peri-urethral abscess and perforation of such a suppuration through the vaginal wall brings about urethro-vaginal fistula. It is to be particularly noted that glandular structures are found in the upper third and in the lower third of the urethra and that these portions present the chronic lesions and are the sites of suburethral abscess.

Infection of the para-urethral (Skene's) ducts affords a nidus for long-continuing suppurative inflammation or recurrent abscess forma-

from the urethra, but are present at this time in secretion from other parts of the genital tract, this bacterium may reasonably be presumed to be the exciting cause of the acute urethritis and subsequent searches will usually reveal them in the urethral secretion

The examination of the vagina, vulvo-vaginal glands, and cervix is now usually proceeded with and the vagina cleansed and dried with gauze, and the vestibule, labia, and vaginal outlet cleansed by washing and dried with gauze

The patient passes urine into two sterile beakers. In the portion voided first, shreds, pus and gonococci are found. The second beaker may contain clear urine or it may be cloudy or turbid with pus. The pus in the second beaker may be due to purulent inflammation in the juxta-vesical portion of the urethra corresponding with posterior urethritis in the male, it may be due to cysto-urethritis or to cystitis.

In acute inflammation of the urethra, when the gonococcus is readily demonstrated in the secretion, no urethroscopic examination should be attempted. It is painful, requiring thorough anesthesia with novocaine or cocaine, and the introduction and manipulation of the instrument produce traumatism, with trifling hemorrhages even in the most deft hands, tending to give rise to extension and aggravation of an already grave inflammatory process. No catheter or other instrument should be passed through an acutely inflamed urethra unless imperatively necessary.

If voluntary urination is interfered with by reason of the pain and swelling in the canal, the patient must be instructed to attempt to void urine while sitting in a hot sitz bath or while hot applications are made to the vulva and pubic regions, so that catheterization and its trauma may be avoided.

During or subsequent to the acute stage of gonorrheal urethritis the inguinal lymph nodes may be found enlarged and tender or even the seat of abscess formation. This so-called "bubo" is rare, as compared to its incidence in the male.

After a few days (one to ten days, but two to four days commonly) the subjective and objective symptoms and signs rapidly disappear. Urination becomes normal, urethral discharge is slight, mucoid, with little pus, and the redness and swelling of the meatus disappear. There persists, however, for ten to fourteen days longer the evidence of urethritis with shreds in the urine, a little more than normal secretion from the mucosa, and pus is to be found in the shreds and in the urethral secretion as well as some gonococci.

The orifices of Skene's ducts will usually show for a week or two as distinct red points, just within the meatus on each side, and from them may be expressed a tiny drop of pus in which gonococci may be found on careful search.

If the urethroscope is employed in this stage, red points and infiltrated areas are to be found along the urethra, and these are most numerous and most marked in the parts of the mucosa which are provided with glands, notably at the upper extremity and near the

The so-called Elliott treatment of constantly circulating hot water is said to be helpful when applied to the vagina and urethra in acute gonorrhea. Here again the vulnerability of the gonococcus to heat plus the salutary effects of hyperemia in the inflamed area constitute the rationale of the method.

During the subsidence of the acute urethral reaction it has been the habit in the past to treat the urethra by frequent irrigations with hot potassium permanganate (1 to 4000) hot salvol or argyrol (1 to 5000) solutions, etc. The general tendency of modern therapy seems away from local measures of this sort and in favor of systemic measures until local areas of persistent infection can be demonstrated and dealt with directly.

Complications of Acute Urethritis.—Acute urethritis is in practically every case which is due to the gonococcus accompanied by infection of the para-urethral glands—Skene's ducts.

The treatment of these infected ducts is best carried out after the acute urethritis has subsided and should consist in the effort to destroy the duct by cauterization or coagulation. The injection of antiseptics or weak solutions of caustics so generally advised is usually a prolonged treatment and futile as a curative measure.

The duct can usually be sounded by a fine probe or large hollow needle the point of which has been dulled and rounded. The wire electrode for high-frequency spark coagulation or galvanocautery can thus be used to destroy the infected channel or the needle electrode may be placed in the duct and desiccation accomplished without carbonization.

Cystitis or inflammation of the trigone or vesical outlet (cervico-urethritis) commonly complicates urethritis in the female. Treatment of the urethral inflammation disregarding the bladder usually results in speedy recovery of the bladder inflammation.

Topical applications to the trigone and vesical outlet may be necessary during the subsiding stage. Treatment however which consists in injections through the urethra into the bladder accomplishes the double purpose.

Suburethral abscess is a complication of acute or chronic urethritis which is fortunately rare. This abscess is found below the urethra in the urethro-vaginal septum by extension from submucous glands which are infected and do not discharge their contents into the urethra. The periglandular tissues are infiltrated and inflamed or several minute intraglandular abscesses fuse together to form a gross lesion the size of a hazel nut or hickory nut giving rise to great pain, exquisite sensitiveness and pain and difficulty in voiding urine.

Suburethral abscess is found beneath the anterior one-third of the urethra in which case the para urethral ducts are usually the seat of origin of infection or the suburethral abscess is found below that part of the urethra nearest the bladder (posterior one-third) when the origin is in the glands of the mucous membrane of this part. The proximity to the internal vesical sphincter gives rise to great pain, constant desire to void urine, strangury, etc.

tion In glands and gland-like structures the gonococcus finds its natural habitat, and it is in these structures that it maintains acute, subacute, and chronic inflammation untouched by medicaments applied to the lumen of the urethra, and undiscovered, it may be, by any of the means which we now possess for searching it out

Treatment of Acute Gonococcic Urethritis — The methods of treatment for acute specific urethritis may be divided into (a) palliative, or symptomatic, and (b) active, or gonococcidal

(a) *Palliative Treatment* — Palliative treatment consists in controlling the discomfort of urethral swelling and inflammation and in lessening the dysuria and frequency of urination When pain, urinary frequency and urgency are marked, rest, preferably in bed, a bland diet, forced fluids, alkalinization of the urine, hot sitz baths, hot external vaginal douches and urinary sedatives constitute the most efficacious treatment The following prescription has been found most useful as a urinary sedative in these cases

Codinæ sulphatis	0 25
Tincturæ hyoscyamæ	15 00
Spiritus gaultheriæ	30 00
Aquæ gaultheriæ	q s ad 120 00
Sig — Teaspoonful in water every two to four hours during the day	

Various preparations of sandalwood oil, hyoscyamus, belladonna and salol are sometimes helpful in this regard During the acute inflammatory stage local treatment is inadvisable and if persisted in may lead to troublesome complications

(b) *Active Treatment* — Active treatment is aimed at increasing, or building up, local or general immunity to the specific infection Vaccines have been administered in the past but without encouraging results Foreign protein injections, such as milk, proteose and aolan, are sometimes recommended The effects of the latter type are afebrile Attempts at intradermal immunization by injection of a bouillon filtrate of the gonococcus (Corbus-Feiry) have given the most encouraging results While this substance has been used generally for only two years, it seems to be established as a great aid in developing a systemic passive immunity If given in small doses, 0.05 to 0.1 cc, it may be administered intradermally or intracutaneously once a week during the acute stages The dosage is increased by 0.05 cc weekly until 0.25 to 0.3 cc is given

Another recent development in the treatment of acute gonorrheal infections in women is the artificial pyrexia induced by high-frequency currents This may be continued so that a fever of 105° to 106° F is continued for from three to six hours Since the gonococcus is usually destroyed by a temperature of 103° to 104° F, prolonged for from one to three hours, many of these patients are apparently rid of the exciting organisms after one or two "pyrexia" treatments Such therapy, at present, should be confined to a hospital where the apparatus and patient will both be constantly under the control of a nurse especially trained for the work

the result of acute infection of the glandular structures of the mucous membrane, especially in the juxta vesical portion of the canal produced through traumatism during catheterization during childbirth and through various possible injuries of the urethra as well as the results of those little-understood and often inexplicable cases of urethral lesions occurring during epidemics of grippe and as complications of tonsillitis, pharyngitis nasal and dental lesions. The writer has seen cases of urethral inflammation with purulent exudate coincidental with suppuration about a tooth which disappeared (were apparently cured) when the dental lesion was removed.

Pathology—The pathological condition differs from that found in acute urethritis in the absence (usually) of inflammation diffused throughout the entire mucous membrane of the canal while the glandular structures maintain the discrete foci. There may be but one gland like structure involved as when one of Skene's ducts presents the only focus, or multiple foci may be present as when many minute lesions give rise to a visible purulent exudate which is found at the external meatus or is readily brought to view by pressure upon the canal in such a way as to force it to the meatus. There may on the other hand be so minute an amount of exudate that none is visible even after massage of the urethra and centrifugalization of the first portion of urine passed may reveal only a few scattered leukocytes by microscopic examination of the sediment.

Chronic urethritis is observed at all ages not often in childhood more frequently in young adults and is most common in women who have borne children. It is not uncommon in women of advanced age.

Symptoms.—The symptoms of chronic urethritis are those so often erroneously attributed to cystitis and irritable bladder namely discomfort or pain painful urination at the bladder outlet, abnormally frequent desire for urination rarely urethral discharge pus and shreds in the first portion of urine voided pyuria and hematuria in some cases.

The symptoms of vesical irritability discomfort at the bladder outlet sense of titillation pain on retention of urine frequent or constant desire to pass urine are all sensory disturbances arising in the urethra producing impulses to the reflex centers of micturition. When inhibitory control of this reflex is inefficient to check it, involuntary urination takes place.

If such injury as the traumatism to the urethral structures produced in some cases of childbirth has weakened the internal and especially the external voluntary sphincter the irritation caused by the lesions of chronic urethritis may start the reflex of micturition and the damaged musculature of the sphincters fails to occlude the canal in spite of voluntary efforts and involuntary micturition takes place.

Changes in the urine may be noticed by the patient if marked pyuria or hematuria is manifest. Marked pyuria may be due to a chronic suppurative lesion in the urethra whose exudate passes back through the sphincter clouding the bladder contents. Extension of the urethral inflammation through the sphincter to the mucosa within the

Suburethral abscesses tend to rupture into the urethral canal rather than through the denser tissues of the vesico-vaginal septum and the vaginal mucosa, but this sometimes does take place

The treatment of suburethral abscess consists in giving vent to it as promptly as possible. This can be accomplished by incising the overlying vaginal wall into the abscess cavity, but the danger of urethro-vaginal fistula is great and its repair at a later date may be troublesome. This should be the treatment of abscess near the external meatus. Osgood believes it to be preferable in the case of abscess near the bladder (posterior one-third) to give a general anesthetic, dilate the urethra to normal limits (30 or 31 Chaurière scale) and, if this does not result in discharge of the abscess into the urethra, to incise the floor of the urethra into the abscess, to give the natural physiological drainage without opening the vaginal wall. The likelihood of fistula formation is less and healing has been prompt and uneventful in one or two cases so treated. Bleeding may be quite profuse, but is usually controllable by pressure *per vaginam*. A retained catheter is usually necessary for a day or two, and opiates are required to control the pain.

Chronic Urethritis — Inflammations of the urethra which persist over a long period of time are found in the female as in the male almost without exception in and about glands of the mucous membrane or in gland-like structures. Chronic urethritis is usually the aftermath of an acute inflammation and the persistent lesions are confined to those parts in which glandular structures are found, namely, in the proximal one-third or the distal one-third of this tube. While in many cases it is difficult to demonstrate a purulent exudate in urethral discharge, in shreds in the urine or in suppurative foci by means of urethroscopic examination, there is always a suppurative process going on in the tissue as the basis of this chronic urethritis. When the gonococcus has been the original invader, this organism may in many cases persistently reside in the depth of gland-like structures and maintain a low grade of suppurative inflammation. When the gonococcus is recoverable in the urethral exudate the diagnosis of chronic gonococcal urethritis is made. When, however, the gonococcus is not demonstrable in the secretion obtainable from the urethra while other organisms are present, the organism found may be either the original invader or it may be one which has replaced the gonococcus in the inflammatory tissue (secondary infection).

The sequela of chronic inflammation, such as stricture, "proliferating urethritis," and "fibrous urethritis" (Legueu) have been considered elsewhere.

Infection by the gonococcus is the most frequent cause of chronic urethritis, and, while authoritative statistics upon its frequency are not available, it is recognized as a common condition. Many cases of chronic urethritis are ascribable, with reasonable presumption, to a previous transient acute urethritis of gonococcal origin.

Many cases of chronic urethritis in women, on the other hand, are

by applying the high frequency current through a needle electrode. Desiccation of tissue is to be preferred to massive coagulation.

The result of any treatment of the urethra is in some cases surprisingly painful after the effect of the local anesthesia has been lost so that the direction should be that the patient keep as quiet as possible (in bed) for three to six hours after the treatment and resort to hot sitz baths, hot douches and hot applications, hot-water bag compresses, etc. as needed. Morphine is required in some cases.

Para urethral ducts which persistently harbor infection are treated by passing a small hollow needle through the extent of the duct and injecting slowly a drop or two of 20 per cent silver nitrate, or by passing the wire electrode and destroying the duct by cautery or high-frequency current. These means of treatment of chronic infection of para-urethral ducts are often adequate but some cases are more promptly cured by incising the canal upon a fine-grooved director to lay it open upon the vaginal wall for evacuation of its contents and direct treatment of the tissue involved. Suburethral abscess is rarely the lesion maintaining a chronic urethritis.

The therapeutic problem of chronic urethritis therefore evolves itself into the elimination of local and remote foci of continued infection, the destruction of foci or granular areas within the urethra itself and the proper treatment of cicatricial narrowings (stricture) which have resulted from the prolonged or repeated local infections.

NOTE.—I wish to express my appreciation of the chapter previously written by Dr Alfred T Osgood. In rewriting this chapter I have followed closely and in some instances used directly the text written by him for the preceding edition.

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bladder, upon the trigone and about the vesical outlet is common but does not always take place

All cases presenting the above-mentioned symptoms should be subjected to critical examination of the urethra.

Diagnosis — Palpation of the urethra *per vaginam* will usually localize areas of special tenderness, and rarely small nodular thickenings or larger infiltrations can be thus appreciated. Exudate can sometimes be expressed from the meatus by pressure upon the canal *per vaginam* from the bladder outlet downward to the urethral orifice. This exudate is to be examined carefully for morphological elements (pus particularly), and by search for bacteria in stained spreads as well as by culture. The type of bacterium should always be determined.

Exposure of the distal 1 cm. of the urethra about the external meatus by means of retractors will often reveal the inflammatory swelling, redness, and exudate present in this part.

The orifices of ducts which open upon this mucous membrane are often plainly visible to the naked eye, but more clearly seen with a magnifying glass by red areolæ surrounding them.

The lesions inside a narrow meatus and those located farther within the urethra are only discoverable through the urethroscope. By means of the urethroscope areas of soft infiltration, of dense induration, as well as the common multiple minute points of swelling, redness, and suppuration can be readily recognized and directly treated. "Granular urethritis" is the chronic inflammation of the mucous membrane which resembles granulation tissue and is found in isolated circumscribed areas or occupying the whole extent of the canal. The gross appearance as seen by the urethroscope is the same in the chronic inflammation due to the gonococcus as in that due to pyogenic cocci, the colon bacillus or other organisms. The differential diagnosis between the inflammations produced by different bacteria can be made solely by the demonstration of the bacterium present.

Treatment — The treatment of chronic urethritis produced by the gonococcus and by other organisms is in general the same, and consists chiefly in direct topical application to each lesion. This can be done satisfactorily only through the urethroscope or the skenoscope.

Gonococcic inflammation because of its infectiousness demands special and stringent precautions against transmission to others. When chronic gonococcic urethritis is present, all contaminated vulvar pads, compresses, clothing, etc., must be destroyed or sterilized and preserved from contact with other individuals. Coitus is interdicted and the patient, nurses and others concerned in the case must be instructed concerning the dangers of contamination to the eyes and other parts, and the strictest cleanliness observed. The dangers of infection of children (male as well as female) must be particularly pointed out. The patient must sleep alone.

The direct treatment of the lesions discovered by the urethroscope aims to destroy each focus. If the superficial tissue (the mucosa of the canal) presents evidence of inflammation, each point should be treated

CHAPTER IX

STRICTURE OF THE URETHRA.

By EDWARD L. KEELY, M.D. F.A.C.S.
AND
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URETHRAL STRICTURE.

STRICTURE of the urethra is an abnormal constriction or loss of distensibility of that channel. The term *dysectasia* (lack of distensibility) applied by Legueu to stricture of the bladder neck, is appropriate to all strictures, for the loss of elasticity at a constricted point in the urethra forms a check to the wave of urine, and thus causes what we know as stricture.

Stricture occurs in the female as well as in the male urethra. In either sex it may be classed as congenital, inflammatory, and traumatic.

Further subclassification may be made as follows

Stricture of the male urethra	{	Congenital
		Traumatic.
	{	Inflammatory
		Gonorrhoeal
Stricture of the female urethra		Tuberculous.
		All others.

Stricture of the prostatic urethra is a 'prostatic retention' physiologically and pathologically to be classified with prostatic hypertrophy.
See Chapter XVIII

It is important to specify how much narrowing or loss of distensibility of the urethra constitutes stricture for whether the lesion be congenital or acquired it merits the name of stricture only after it has reached a point of contraction at which it is inevitable either that symptoms result or that further contraction ensue. But the size varies with different types of stricture as well as for different urethra. It is equally impossible to specify the precise size to which a stricture must be dilated in order that its tendency to recontraction may be controlled.

Thus a congenital stricture no larger than 20 F. is likely to give no symptoms unless its possessor acquires a gonorrhoea which cannot be cured until the stricture is cut.

On the other hand any traumatic scar surrounding the urethra will soon contract sufficiently to cause symptoms to be clinically a stricture.

For gonorrhoea stricture Oberlaender recognizes hard infiltrations of various degrees a urethroscopic tube of 23 F. size being the criterion. Infiltrations of the first degree do not perceptibly impede

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In the anterior urethra gonorrhoeal stricture is coterminous with gonorrhoeal urethritis with the urethra itself. An utterly neglected case thus sometimes presents irregular bands of stricture at short intervals from one end of the urethra to the other. But such cases are rare. The symptoms of neglected stricture usually cry for relief long before so extensive a process can develop.

In the majority of cases strictures are pathologically single though they may be clinically multiple; i. e. there is but a single scar affecting a greater or less extent of the urethra upon the surface of which there may be one or more ridges presenting points of obstruction to the examining instrument. Hence the clinician notes the frequency of multiple strictures while the pathologist asserts their rarity in that very class of (postmortem) cases in which their multiplicity should be most apparent. Thus Thompson¹⁰ found only 41 cases of multiple stricture among 270 museum specimens. Only 5 of these extended throughout the urethra.

Thompson¹⁰ suggests the following division of the urethra for the classification of gonorrhoeal strictures.

I. The bulbomembranous from 1 inch in front of to $\frac{1}{2}$ inch behind the junction of the spongy with the membranous urethra. This region contains the majority of strictures; they lie rather in front of than behind the junction of the bulb with the membranous urethra.

II. From the anterior limit of region I to within $2\frac{1}{2}$ inches of the meatus.

III. The terminal $2\frac{1}{2}$ inches of the canal.

Thompson found 213 (67 per cent) strictures in region I, 51 (10 per cent) in region II, 44 in region III. Among 364 of our cases 340 (61 per cent) were in region I.

The Form of Stricture—It is convenient to speak of linear, annular, or tortuous strictures. These terms correspond to clinical characteristics.

Two more important points in reference to the form of stricture must be borne in mind. In the first place the scar of stricture of the penile urethra is built up chiefly from the floor of the urethra. Its orifice is, therefore, eccentrically placed and usually near the roof of the canal. But quite the opposite is often the case in the bulbous urethra.

In the second place irregular multiple strictures usually become progressively narrower as they approach the bulb. Even though the stricture extends over only a short portion of the urethra its tightest point is likely to be the deepest while if its extent is considerable examining instruments encounter tighter and tighter bands until the tightest point of all is found in the deeper portion of the bulb. Thus the minimum size noted in 439 of our cases is shown in the subjoined table.

Impassable	I regions I and III	In region I
Uniform to 9 F	3	
10 to 10 F	1	
10 to 10 F	65	
10 to 10 F	6	
	<hr/> 151	
		305

the glands, into the surrounding corpus spongiosum, and even beyond this into the subcutaneous tissue. These processes have been described in reference to gonorrhea. Suffice it to state that the mildest of them results in superficial scarring of the mucosa, which at most can only cause a slight contraction of the urethra. The more extensive and intensive processes result in grave stricture, peri-urethral abscess, fistula, etc.

With the cicatrization of this peri-urethral exudate a scar is formed in the urethral wall. This contains a large proportion of elastic fibers. It tends to contract. It diminishes the lumen of the urethra. At first the actual encroachment upon the urethral lumen is slight, but the physiological impairment, the dysectasia, is great. The outflow of the urinary stream meets an obstacle in this rigid portion of the urethral wall, an obstacle that continues to harbor gonococci or other bacteria in its inflamed glands, and whose surface is eroded or ulcerated. Repeated impact of the urinary stream against this tends to dilate the urethra behind it and to intensify the chronic urethritis about it. As a result, more periglandular exudate is formed, more scar results, the urethral lumen is still further narrowed, while the chronic urethritis is encouraged. The complications of anterior urethritis, viz., peri-urethritis and peri-urethral phlegmon, abscess, and fistula, are common results of neglected stricture.

Urinary sepsis due to retention and infection of the upper urinary tract results from stricture, just as it does from prostatic retention (*q v*), but inasmuch as the patient with stricture is usually several decades younger than the possessor of an enlarged prostate, his younger and stronger muscles tell in his favor. His bladder is more likely to become hypertrophied (sclerosis with thickening of the wall, but without dilatation of the cavity) than atrophied. If relieved of his stricture, even after his kidneys have suffered grave damage, his expectation of life may be considerable.

Postmortem examination of urethral stricture may only reveal a transverse scar in the mucosa so slight that it can be felt rather than seen when the urethra is split open. The surface of the mucosa may look normal, it may be eroded, granulating, pouched from back pressure, or, in the more extreme cases, utterly distorted by irregular masses of scar and areas of suppuration.

Location of Stricture—In the preceding paragraphs gonorrheal stricture has been described as though it affected the anterior urethra exclusively. Such is not the case. Gonorrheal stricture of the membranous urethra has been observed, and one occasionally operates upon a urethra strictured not only from meatus to bulb but also throughout the posterior urethra.

Gonorrheal stricture of the prostatic urethra does not concern us here. Stricture of the membranous urethra is never seen alone, it is an extension of stricture in the bulb. With the exception of sclerosis of the bladder neck, gonorrheal strictures of the posterior urethra may be dismissed with the statement that they add nothing to the clinical picture or to the treatment of gonorrhea of the anterior urethra.

of catarrh usually antedate those of obstruction that the obstruction may come on so gradually as not to fix the patient's attention until it has become complete or until the hemorrhage from an ulcer or the pain and fever from a secondary infection of kidney or epididymus clamor for relief.

Chronic Urethral Discharge — The chronic urethral discharge of stricture (commonly called gleet) is usually little more than a drop of pus at the meatus in the morning. By the time definite stricture develops, gonococci are likely to have disappeared and been replaced by other bacteria though reinfection is not uncommon. The urine passed always contains shreds and these are usually of considerable size. These shreds are derived from the inflamed or ulcerated surface of the stricture and the adjacent portions of the urethra.

The presence of free pus enough to cloud the urine depends upon a superadded urethritis, prostatitis or infection of the upper urinary tract. It should be borne in mind that large shreds are suggestive of stricture while free pus in the urine is to be referred to the inflammation accompanying stricture.

Frequent and Obstructed Urination — As the stricture grows tighter the act of micturition requires more effort and the last drops of urine dribble away. Chronic urethritis is kept up and this inflammation extends to the prostate. The resulting irritation and infection of the prostate, bladder and kidneys cause *frequent and painful urination*. These symptoms are by no means pathognomonic of stricture. Indeed the dysuria due to infection may quite overshadow the sense of obstruction due to stricture.

Changes in the shape or the force of the urinary stream may be due to so many conditions other than stricture that they deserve no special notice. The split or deflected stream is often due to a drop of pus in a tight meatus. The shape of any stream is imparted to it by the nozzle from which it flows.

Acute Retention — Acute complete retention of urine (sudden complete—or almost complete—occlusion of the urethra) is due to the sudden congestion of a canal already partially obstructed by stricture. This congestion is similar to the like condition complicating prostatic retention and is attributable to like causes, *e. g.* voluntary retention of urine, alcoholism, exposure to cold, etc. Though the stricture is usually very tight, I have seen acute complete retention of urine due to stricture that readily admitted a 20 F. sound. Moreover it is a common place observation that the patient whose stricture is so tight that no instrument can be passed through it may yet retain his ability to urinate, refuse further treatment and go several months or years before acute retention occurs.

The retention due to stricture differs in one most important particular from that due to prostatism. Either condition may cause acute complete retention but partial retention is not caused by urethral stricture unless that stricture is complicated by some form of prostatic retention such as prostatic abscess or stricture at the neck of the

Thus, of the anterior strictures, less than 16 per cent contracted below 10 F, while of the perineal strictures, 54 per cent did so. Anterior strictures contract to a far less degree than perineal strictures.

We note, however, that when the anterior structures do contract below 10 F the bulb of the urethra is likely to be free from tight stricture. An impassible or filiform stricture at or about the penoscrotal angle usually implies an open canal beyond.

Symptoms — The symptoms of urethral stricture, like those of prostatic retention, may bear little relation to the gross pathological condition. Thus a patient complaining only of a chronic urethral discharge may be found to suffer from an extensive and tight stricture, while another who suffers from acute complete retention of urine may have but a single narrow band that obstructs the urethra rather by congestion than by actual contraction of scar. Furthermore, the most treacherous stricture cases resemble those cases of prostatism of which the local symptoms are few, but whose general debility, resulting from chronic renal insufficiency, may bring them to a state of incurable renal deficiency before they even consult a physician.

Onset — The accompanying table compiled from our cases and those of Thompson shows that the symptoms of stricture usually begin within one year of the gonorrhea causing it. Exceptionally, and doubtless through neglect on the part of the patient to be thoroughly treated for a chronic urethritis, the slight scar resulting from this may, after many years, result in true stricture.

	Keyes	Thompson	Total	Per cent
Within 1 year	121	81	202	54
1 to 5 years	38	41	79	21
6 to 10 "	27	22	49	13
11 to 15 "	7	20	27	7
16 to 20 "	8	0	8	5
21 to 30 "	9	0	9	
Over 30 "	2	0	2	
	<hr/> 212	<hr/> 164	<hr/> 376	<hr/>

It will be noted that Thompson's cases, founded upon pathological observation, average a much earlier onset than ours, founded upon clinical data.

The Initial Symptom — We have tabulated the initial symptom of 422 cases with the following result:

Chronic urethral discharge	238
Obstruction to urination	77
Frequency of urination	53
Acute complete retention of urine	31
Pain	8
Peri-urethritis	7
Hemorrhage	3
Overflow from retention	2
Persistent chordee	2
Epididymitis (symptoms of)	2
Pyonephrosis (symptoms of)	1

This list suggests among other things that some patients are far more alert to observe their symptoms than others, that the symptoms

sound may promptly control profuse hemorrhage. Such hemorrhage was noted three times as the initial symptom and in four other of our cases as a striking symptom.

Sexual Symptoms—The sexual deficiency, the impotence the neurasthenia and the various pains radiating from the prostate and seminal vesicles, that were attributed by a preceding generation to urethral stricture are much more commonly seen in patients who have no stricture whatever and are themselves rarely directly referable to stricture. Tight stricture does indeed often cause inflammation of the colliculus, the prostate or the vesicles such as will interfere with their function but sexual symptoms are due to sexual causes. They are not relievable by dilatation of the stricture.

Pain—Various types of pain result from stricture. Painful urination has been alluded to. Painful erection amounts practically to chordee in some cases of extensive stricture in the region of the peno-scrotal angle if accompanied by considerable inflammation. Perineal and other pains are due to the accompanying or resulting inflammations of the internal sexual organs.

Complications of Stricture—*Prostatitis and Vesiculitis*—These complications are so common as to be almost part of the usual clinical picture of the disease.

Renal Retention and Infection.—The silent progress of renal infection sclerosis and dilatation is the most insidious and dangerous complication of stricture. It is the cause of urethral chill and urinary septicemia (whether or not excited by the passage of instruments) and of almost all the deaths resulting from the stricture itself or from its treatment. Unnumbered lives are shortened through reduction of renal efficiency. Even though the stricture itself be properly controlled the resulting renal lesion permanently impairs the resistance of its host to such hardships accidents and maladies as he may encounter.

No statistics can convey the precise importance of these secondary renal lesions. The least we can do is to be always on the alert, to include them in our diagnosis and to make allowance for them in our treatment. A lean patient with persistently dilute urine and an ancient stricture is in as much danger from instrumentation as is the prostatic in a comparable condition of fixed sclerotic renal insufficiency. Urethral chill (ureteral reflux with ensuing septicemia) will some day follow the gentle passage of his accustomed sound, and he will be dead in forty-eight hours.

Peri urethritis and Prostatic Abscess—Peri-urethral suppuration either at the site of stricture or arising from the prostate or Cowper's glands, was noted in 22 of our cases. The course and treatment of these complications do not materially differ from those described as complications of urethritis.

Peri-urethral Gangrene—Peri-urethral gangrene though it sometimes occurs in a patient whose urethra is normal is usually a complication of stricture. Thus the ancients called extravasation of urine.

bladder. Hence, the kidneys of a patient with stricture defy neglect in spite of repeated attacks of acute complete retention for a much longer time than those of the victim of prostatic retention. For the strictured urethra, if it permits the bladder to empty at all, permits it to empty completely.

A large proportion, perhaps a majority, of attacks of acute retention with stricture are relieved almost spontaneously. The patient at first vainly struggles to urinate. If inexperienced, he promptly becomes panic-stricken and increases his agony by struggling to overcome what is for the moment an insurmountable obstacle. The torturing spasms recur every few moments until a physician brings relief, or the spasm relaxes and a dribbling, hesitating stream gradually relieves the retention. (The third possible alternative, viz., death by exhaustion or rupture of the bladder, I have never seen.)

The experienced victim, on the other hand, recognizes the thin stream that foretells retention and takes his precautions accordingly. He restrains his efforts to urinate, lies down, takes a hot hip-bath, and so often wards off the attack. Yet these palliatives sometimes fail, and he, too, has to summon professional aid.

The recurrence of acute retention depends more on the accident of congestion than on the tightness of the stricture. Most patients who have had complete retention may look for repeated relapses at intervals of a few weeks or months unless they submit to dilatation. But exceptionally they escape for an extraordinary length of time. Thus, I have records of one patient who had but three acute retentions in eight years, though never dilated. Another had a single retention (undilated) ten years before he came for treatment. A third, discouraged by the failure of any instrument to pass his stricture, consulted no physician and had no retention for fifteen years thereafter. But such reprieves are neither to be expected nor to be desired. During these years the destructive effects of renal retention and infection progress silently but steadily. The close observer will note a type of incomplete retention of urine due to bladder atony behind a dense stricture, neglected but perhaps not very tight. The typical case has a dense, old stricture of the bulb. Urination is slow, but infrequent. A 20 F sound is grasped. A woven catheter draws 50 to 100 cc of residual urine. After the first treatment the residual urine disappears. Subsequent examination reveals no prostatic hypertrophy, no sclerosis at the bladder neck. This condition is due to atony, it is, as it were, the ghost, the "makin's," of an acute complete retention.

Hemorrhage — Apart from the bleeding excited by instrumentation, or resulting from acute prostatitis, hemorrhage is a rare symptom of stricture. It is likely to occur early, to be quite profuse, to assume the form of urethrorrhagia (hemorrhage between the acts of urination), with more or less hematuria. The bleeding during urination is likely to be terminal (most marked toward the end of the act). This bleeding, like that of fissure *in ano*, is due to ulceration, and is promptly and brilliantly controlled by dilatation. The passage of a single

sound may promptly control profuse hemorrhage. Such hemorrhage was noted three times as the initial symptom and in four other of our cases as a striking symptom.

Sexual Symptoms—The sexual deficiency, the impotence, the neurasthenia and the various pains radiating from the prostate and seminal vesicles that were attributed by a preceding generation to urethral stricture are much more commonly seen in patients who have no stricture whatever and are themselves rarely directly referable to stricture. Tight stricture does, indeed, often cause inflammation of the colliculus, the prostate or the vesicles such as will interfere with their function, but sexual symptoms are due to sexual causes. They are not relievable by dilatation of the stricture.

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No statistics can convey the precise importance of these secondary renal lesions. The least we can do is to be always on the alert to include them in our diagnosis and to make allowance for them in our treatment. A lean patient with persistently dilute urine and an ancient stricture is in as much danger from instrumentation as is the prostatic in a comparable condition of fixed sclerotic renal insufficiency. Urethral chill (ureteral reflux with ensuing septicemia) will some day follow the gentle passage of his accustomed sound and he will be dead in forty-eight hours.

Peri-urethritis and Prostatic Abscess—Peri-urethral suppuration either at the site of stricture or arising from the prostate or Cowper's glands was noted in 52 of our cases. The course and treatment of these complications do not materially differ from those described as complications of urethritis.

Peri urethral Gangrene—Peri urethral gangrene though it sometimes occurs in a patient whose urethra is normal is usually a complication of stricture. This the ancients called extravasation of urine.

Gangrene that complicates stricture does indeed start in the scarred urethra, but as an inflammatory, not a mechanical lesion

The gangrene occurs only in a debilitated individual and is seen almost exclusively among the neglected poor who seek refuge in a city hospital. Beginning with a localized inflammatory swelling, the gangrene starts in the subcutaneous tissue, and spreads with devastating rapidity. Within a day or two the scrotum, perineum, and penis become swollen, tense, purple—the scrotum a ball of 15 to 20 cm in diameter, the penis a huge sausage. The exudate occurs within Buck's fascia and is slow to reach the buttocks, while it rapidly extends to the groins and thence to the loins. The testicles and spermatic cords are spared, as are the corpora cavernosa, but the gangrene may destroy several centimeters of the corpus spongiosum in the region of the stricture.

The gangrenous tissue harbors streptococci, erysipeloid in character, and various anaerobic bacteria.

The stricture occasionally is quite a wide one through which a 16 F woven instrument readily enters the bladder. Retention of the urine is often present, the result of the patient's debility or of the tight stricture.

The patient is intensely septic and unless promptly operated upon is likely to die in a few days.

Epididymitis — Infection of the epididymis, as a result of urethral stricture, is usually the work of the bacillus coli or of the pyogenic cocci. Hence it is much more likely to suppurate than is gonorrheal epididymitis. Although this complication discourages urethral instrumentation, it may nevertheless be imperative to relieve a tight stricture, even in the presence of an acutely inflamed epididymis. Under such conditions the complication may sometimes prove an argument whereby the surgeon may persuade the patient to submit to perineal section together with drainage of the epididymis.

Other Complications — Among the rarer complications noted among our cases, we may mention 2 cases of prostatic stone, 3 of bladder stone, and 2 of stone in the kidney. Arthritis was only once noted. One would fancy its actual frequency greater than this.

Complications Due to Treatment — Among the most important complications of urethral stricture are those resulting from improper treatment. Too great brutality in passing instruments may result in added scar, urethral chill, urinary septicemia, epididymitis, peri-urethritis, prostatic abscess. Failure to enter the stricture may result in false passage and peri-urethritis. Enthusiastic internal urethrotomy may result in permanent incurvation of the penis, of which 5 cases appear upon our list.

Diagnosis — The diagnosis of urethral stricture must include the diagnosis of chronic anterior urethritis and of such complications as peri-urethritis, prostatic abscess, renal infection and retention, etc., since the presence of these materially influences prognosis and treatment.

Moreover, the diagnosis of stricture itself contains an element of

prognosis, for one must determine not only whether actual stricture exists but whether stricture is likely to occur or if previously existing and under control to recur

Asepsis and Insensibility—The diagnosis of stricture is made by the introduction of instruments into an inflamed canal. Among the most important results of stricture are renal retention and infection. Such cases are in the same state of unstable renal balance as are the prostatitis. The passage of sounds is peculiarly qualified to excite reflux pyelonephritis (urethral chill) or anuria. Therefore the precautions elsewhere laid down for urethral asepsis and antiseptics must be most minutely observed. Instruments must be passed with the greatest gentleness and it is actually a measure of precaution to precede the passage of urethral instruments by an injection into the urethra of 5 per cent novocain solution, to be retained at least fifteen minutes before the instruments are introduced. This is grateful to the patient for it diminishes his pains, though this should not be taken advantage of by the surgeon. The skill of the urologist is measured by his gentleness.

The Urethroscope—The urethroscope may be employed for the diagnosis of stricture of large caliber. The straight open-end tube should be used. If the stricture is large enough to admit the tube, the urethral wall is seen to be rigid in that it does not fall together into the usual radiating folds. Indeed the scar if dense holds the urethra relatively open on the end of the urethroscope. The surface of the mucous membrane is usually inflamed, eroded and even ulcerated, most markedly at the point of stricture and to a less degree both before and behind this. If the surface inflammation is under control however the mucosa looks shiny, whiter than normal and quite bereft of its usual folds.

The tight stricture which will not admit the urethroscopic tube usually bleeds so freely that the examination is of little value.

The Oligary Bougie—This is the instrument for the diagnosis of stricture. With a complete set of bougies (from 6 to 28 F) one may diagnose with accuracy the size of the various constrictions in the anterior urethra. Filiform strictures elude precise diagnosis by the bulbous bougie but all other constrictions are perceptible as bands through which the bulb of appropriate size slips with a jump.

We begin our examination by passing a 26 F bulbous bougie. (Stricture of the meatus should be cut (p. 386).) This is gently introduced until it meets an obstacle. If a stricture of large caliber this obstacle is passed with a jump while the patient announces a corresponding pain. If a tighter band is encountered the bulb cannot be pushed beyond this but must be withdrawn—with a hitch over the large structure—and replaced by a smaller one. Thus we calibrate strictures as far as the bulb. But the bulbous bougie may fail to engage in the bulbomembranous junction of the most normal urethra. Strictures at this point must therefore usually be calibrated by sounds.

The urethrameter of Otis theoretically gives the most accurate picture of urethral constrictions. I have never employed it.

Gangrene that complicates stricture does indeed start in the scarred urethra, but as an inflammatory, not a mechanical lesion

The gangrene occurs only in a debilitated individual and is seen almost exclusively among the neglected poor who seek refuge in a city hospital. Beginning with a localized inflammatory swelling, the gangrene starts in the subcutaneous tissue, and spreads with devastating rapidity. Within a day or two the scrotum, perineum, and penis become swollen, tense, purple—the scrotum a ball of 15 to 20 cm in diameter, the penis a huge sausage. The exudate occurs within Buck's fascia and is slow to reach the buttocks, while it rapidly extends to the groins and thence to the loins. The testicles and spermatic cords are spared, as are the corpora cavernosa, but the gangrene may destroy several centimeters of the corpus spongiosum in the region of the stricture.

The gangrenous tissue harbors streptococci, erysipeloid in character, and various anaerobic bacteria.

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Some emergencies *e g*, an acute retention of urine do not permit delay. The diagnosis of stricture must be combined with the relief of retention. Under such circumstances it may be wiser to begin at once with filiforms since these are so much more likely to enter the stricture if no previous instrumentation has been attempted. The manipulation of filiforms is described in reference to treatment.

After the diagnostic instrumentation the urethra should be cleansed with the routine antiseptic irrigation.

The Diagnosis of Impending Stricture—Of even greater importance and delicacy than the diagnosis of existing stricture is the diagnosis that stricture is about to occur.

Impending stricture should be suspected in every case of chronic anterior urethritis. It is disclosed as a soft infiltrate by the passage of bulbous bougies (up to 28 F). This bougie catches and perhaps even fails to pass a given point. When withdrawn blood follows. But the sound is not grasped. The urethroscope shows a thick, rigid, inflamed mucosa quite like that which covers stricture. Intelligent dilatation will lead to the resorption of those inflammatory exudates that cause urethritis and form the origin of the scar that would subsequently form stricture.

But if the patient has been treated elsewhere and one does not feel sure that he ever had a true stricture the diagnosis of a possible recurrence should be deferred for a year. At the end of this interval without treatment, if the urethra readily admits a 28 F sound and the urethroscope shows no sclerosis of the wall of the canal the patient may safely be dismissed as free from the prospect of relapse.

Course and Prognosis—Inasmuch as the clinical picture of gonorrheal urethral stricture is a composite of scar and inflammation more or less controllable by treatment and subject to the vicissitudes of intercurrent gonorrheas and other sources of irritation it is obviously quite impossible to compose a picture that shall adequately represent the usual course of this disease. Slight chronic urethral discharge may be for many years the only symptom while this may be absent altogether and only the large shreds in the urine suggest the presence of stricture. Retentions may be frequent and rapidly recurrent. Yet exceptionally a single retention relieved without any real treatment of the stricture may be followed by an interval of years before retention recurs. Perhaps the interval between the appearance of symptoms suggesting stricture and the beginning of treatment, will hint, as well as figures can, how various is the progress of this malady.

We have tabulated the time at which treatment was begun in 285 cases

	Cases	Per cent.
Within six months	63	32
From six to twelve months	22	
During second year	27	
" third to fifth year	77	36
" sixth to tenth year	30	
" eleventh to twentieth year	30	
Beyond twentieth year	13	4

Sounds and Bougies —The urethroscope gives a picture of the surface lesions of the canal. The bulbous bougie gives precise information as to the tightness of each stricture band. The sound and the conical bougie do not give such precise information, but they do tell us that stricture does or does not exist. They inform us as to its approximate diameter and dilatability.

The sound elicits the essential diagnostic sign of stricture, viz, *grasping*.

If it engages in a stricture, the sound passes onward with a distinct sense of resistance, while the patient complains of more or less pain. The maneuver at this juncture must be extremely gentle. If the stricture is in the bulb, the unwary operator may be misled by the fact that he can depress the handle of the sound into the belief that its point is progressing toward the bladder. To avoid this error let him watch closely the disappearance of the shaft within the meatus. The progress of the point of the sound is measured by the disappearance of its shaft.

But if the sound, thus gently introduced, progresses with no undue resistance into the bladder, the true stricture (as distinguished from purely inflammatory or spasmodic obstruction) *grasps* the instrument and resists its withdrawal. Any sound that will enter the unstrictured urethra will fall out again by its own weight. But true stricture grasps the sound, which can only be withdrawn by force. Indeed, the effort to withdraw the instrument may be greater than that required to introduce it. This grasping of metal instruments is pathognomonic of stricture. Woven bougies are sometimes, rubber catheters often, grasped by spasm of the cut-off muscle in the unstrictured urethra.

If the sound fails to engage, smaller instruments are successively introduced until one enters the stricture. At or below 20 F it is safer to employ Philips' bougies rather than metal instruments, and with these to continue, if necessary, until a number 10 F fails to pass. Then we know that either the stricture is so small it will only admit a filiform bougie (a so-called filiform stricture), or else there is no stricture at all. *For no final diagnosis of stricture can be made until an instrument shall have passed through and been grasped by the scar.*

Suggestions of the presence of stricture other than this are indeed many. The patient's history or other physical signs may point to stricture. The sounds which fail to pass may be interrupted before their points have settled well into the bulbous portion of the urethra. The most gentle manipulation may produce profuse bleeding. Such signs point to stricture, but they do not infallibly prove its existence.

If all but filiform instruments fail, a few attempts may be made with these. But these tentative sounding may so bruise the stricture that even a filiform will not find its way in. It is therefore wiser to defer any serious attempt at passing a filiform until the following day. Then we may resume the examination, beginning with the passage of filiforms.

¹ The Philips bougie is a woven conical bougie that is to be introduced, threaded onto, and following a filiform instrument.

traction of such a stricture need be feared. It is not to be forgotten however that such strictures are often accompanied by stricture of the bulbous urethra. This shows the usual tendency to recontract.

Generally speaking therefore stricture of the bulb is dilatable but incurable while stricture of the peno-scrotal angle or of the penile urethra responds poorly to dilatation but is eminently curable. Inflammatory stricture at the meatus, be it said, is the extreme example of undilatability. Yet it is always cured by adequate section.

Treatment.—The treatment of gonorrheal stricture may be preventive palliative or curative.

PREVENTIVE TREATMENT—The preventive treatment of stricture begins long before the stricture. Its foundation is a discreet management of acute gonorrhea for a gonorrhea thus managed should leave behind little or no trace of its passage in the form of peri-urethral exudate. Just as the breaking of chordee the use of cauterizing injections, too much zeal in the passage of urethral instruments, etc. are causes of gonorrheal exacerbations and complications so gentleness and discretion eliminate these causes and prevent stricture.

Once chronic anterior urethritis has been established the treatment of this is calculated to cause resorption of the exudate before it forms scar.

PALLIATIVE TREATMENT—The palliative treatment of urethral stricture consists in dilatation. From what has been said in discussing the progress of stricture it will be readily understood that dilatation may occasionally cure a stricture. But, the prime object of dilatation is to control stricture not to cure it. No amount of stretching can banish a scar from the urethral wall. So long as the scar is there it is likely to recontract. Indeed the scar as such cannot be dilated. Dilatation is massage employed for the purpose of encouraging resorption of inflammatory exudate. If rough it increases the exudate and lays down new undilatable scar. The physician therefore will be well advised to consider his dilatation purely palliative. *Stricture at the meatus* whether congenital or inflammatory must be cut.

Intubation and Anesthesia—The most rigorous asepsis of instruments patient's urethra and physician's hands should be practised as a matter of routine. But, inasmuch as the patient's urethra cannot be cleansed of the bacteria that lurk within its glands the two essential elements to prevent complications are

1 *Extreme gentleness* in the passage of all urethral instruments, whereby the urethral wall is spared and the foci of infection within are not stimulated to activity.

2 *Intubation* by an irrigation with a mild antiseptic such as acriflavin.

The anesthesia produced by filling the anterior urethra with 5 per cent novocain for 10 minutes before the passage of instruments may be employed for each dilatation. It is usually quite possible after a few treatments to proceed with dilatation without any local anesthetic. Indeed the patient may not note the omission.

Yet in all this uncertainty there is some regularity of prospect which may be sketched as follows

The progress of stricture is measured by the promptness and intensity of its onset on the one hand, opposed by the efficiency of treatment on the other. Thus a stricture that has for its only symptom a mild gleet, or that begins many years after the last gonorrhea, is likely to be a slight scar, to contract slowly and may perhaps be neglected with impunity for a considerable period. On the other hand, a stricture that begins early and with symptoms of obstruction or retention is likely to be a dense scar and to progress rapidly.

Furthermore, acute retention of urine, whether relieved by dilatation or not, usually recurs within a year, if the stricture is neglected.

Strictures of the pendulous urethra contract more slowly and, even when neglected, to a less degree than those in the bulb. Yet (as we shall see) strictures of the bulb are far more amenable to dilatation than those of the anterior urethra.

Although in the absence of intercurrent gonorrhea acute prostatic or renal suppuration are rarely seen before the stricture has become very tight, peri-urethral phlegmon, suppuration or gangrene may result from a stricture of relatively large caliber.

Cure—Stricture is part infiltrate, part scar. Inasmuch as it is scar it cannot be cured. True, its contraction may be prevented and even overcome by resolution of the inflammatory infiltrate under the massage of dilatation. But one cannot dilate scar. When the scar of stricture is the cause of constriction (as it is much more commonly in the narrow pendulous urethra than in the wider bulb), no dilator or sound will dilate it. The most instruments can do to scar is to tear it and make more scar. To open scar one must cut it, then dilate, and thus splice the ring with new scar.

It is impossible to assure any patient with absolute certainty that his stricture will never recontract. But in this matter the distinction between stricture of the bulb (Thompson's region III) on the one hand and stricture of the pendulous and scrotal urethra (Thompson's regions I and II) on the other is striking.

The deeper strictures, though they can often be readily dilated, show an almost universal tendency to recontract. A fully dilated stricture is likely to recontract to the point of giving retention in from one to five years. Exceptionally the recontraction is slow, so that even ten to fifteen years later a small sound can still be passed, while most exceptionally the stricture does not recontract at all. I have followed several cases that showed no evidence of recontraction for more than ten years.⁴

Stricture at or external to the peno-scrotal angle, on the other hand, if it has once formed a dense scar, is rebellious to dilatation, but when cut to no larger size than 34 F. may usually be kept widely dilated by the passage of sounds, and if this treatment is continued until the cut has healed and the adjacent urethritis is cured, no further recon-

Dilatation of Stricture at the Meatus—It is a waste of time to attempt dilatation of strictures of the terminal inch of the urethra. They should be cut.

Dilatation of the Pendulous and Scrotal Portions—Strictures in this region may be dilated if they have existed for a relatively brief period. But, as a rule, they do not yield to dilatation.

Unless they dilate readily they should be subjected to internal urethrotomy, as described below, and dilated to 28 or 29 F. for three months. By this time the mucosa should be healed, the urethritis cured. If so the stricture will not recur, as proven by re-examination a year later.

Strictures of the Bulbous and Membranous Urethra—These the most common of gonorrhoeal strictures yield to dilatation. Unless complicated by trauma or *pain* urethritis they can, as a rule, be controlled by the intelligent passage of sounds. Yet even here urethrotomy is called for when dilatation fails.

The Technique of Dilatation—Let us suppose a stricture in the bulbous urethra that will admit only a filiform instrument. By describing the series of treatments whereby this is fully dilated we shall cover the ground.

The diagnosis has been established by vain attempts to pass larger instruments. We now resort to filiforms.

We select a filiform, bend its tip a little eccentrically, and introduce it slowly into the urethra. It catches here and there, whereupon we withdraw it, rotate the point to one side, and so pass the obstacle. If we are fortunate the filiform passes the stricture readily, but usually it is obstructed. It will not engage in the stricture. Then it must be patiently and gently moved up and down, turning the point now to the right, now to the left, but searching for the orifice of the stricture rather toward the roof of the urethra than toward its floor. If the point of the filiform finally slips into the stricture, it may be obstructed by catching in the utricle or in some pocket of the posterior urethra. That the filiform has passed the stricture is recognized by estimating the depth to which it has penetrated in the urethra. That it is caught in the posterior urethra is verified by a finger in the rectum pressing against the membranous urethra. The filiform is gently moved to and fro until the pressure of the finger makes it ride out of this obstacle and into the bladder. Then the follower is screwed onto the filiform and gently pushed into the bladder.

The filiform is not so sure a guide as might be imagined; it will buckle and even break if the follower is pushed in with too great haste. The size of the follower should vary with the age and density of the stricture. If the stricture is thought to be but a single band, and the scar so slight that no definite irregularity can be felt in the perineum at the point of stricture, one may sometimes advantageously employ a follower as large as 14 or 16 F. But if the scar is an ancient indurated mass, the first instrument passed should be no larger than a 10 F., and it is often wiser to attempt no further dilatation until several days later.

DILATATION — Instruments Required — A complete equipment of dilating instruments includes filiform Philips bougies and followers, woven bougies, conical sounds and dilators

Filiforms and Followers — The filiform bougie should have a smooth, rounded, olivary point and a flexible neck, which can be temporarily bent at any required angle. One should possess instruments whose tips vary considerably in size.

Filiforms are made in two types. The one, a whalebone instrument to be used with a tunnelled sound or catheter, the (Philips) other, a woven instrument, to the butt end of which is affixed a screw, whereby it can be screwed to a following sound or catheter. I much prefer the latter type. It has a more flexible point which can be set at an angle by a drop of collodion. Its screw junction with the following instrument is, of course, much smoother than that of the whalebone-tunnelled combination.

Filiforms are sometimes made with their points set in curious corkscrew shapes, these have no advantage. The point of the filiform should be of little offset from its center, so that, after it has been introduced as far as the face of the stricture, it may be revolved to make its point search over a limited area for the orifice. Any complicated angulation is wasted.

Woven Bougies — With the filiform and its followers the stricture can be conveniently dilated to 10, 15 or even 20 F, though it is preferable to use woven olivary-tipped bougies, after the first passage of filiform and follower. A set of bougies runs from 10 to 22 F. Bougies weighted with shot, or with a lead core, are rather preferable since their weight makes them dilate the stricture somewhat more forcibly.

Sounds — When skilfully manipulated, the conical steel sound actually causes less pain than the woven bougie. But the sharp point of a small-sized sound is so likely to catch in the urethral wall that, as a general rule, one employs woven instruments up to size 20 F, and sounds from this point to the limit of the meatus. I employ a sound larger than 29 F only after urethrotomy.

On the other hand, the fixed curve of a steel sound makes it an admirable instrument for entering the orifice of a tight stricture in the bulbous urethra. I have not unfrequently entered a stricture with the 10 or 12 F steel sound, the orifice of which I could not locate with the filiform. But the maneuver is so difficult that it should only be attempted by the skilled practitioner, the uninitiated will inevitably drive the sharp point of a small sound into the urethral wall. All sounds should engage in the orifice of the stricture by their own weight — small sounds must.

Dilators — Kollmann dilators are admirable instruments for the treatment of chronic urethritis, anterior or posterior. They should never be used in the treatment of stricture. To make a small meatus an excuse for using a dilator (as was suggested by one of us in the preceding edition) is quite mad. Unless the meatus will take a 28 F sound, the chronic urethritis cannot be cured — the stricture will reform.

The ideal interval is from five to seven days for time must be given to the surface of a stricture to recover from the trauma of one instrumentation before a second is attempted. The rapidity of dilatation is of course never twice the same but if the stricture yields rapidly, one need not fear to advance as much as five numbers on any one occasion. Each sitting is begun with the passage of an instrument at least one or two sizes smaller than the largest instrument previously passed. If this fails to enter one may have to return to the smaller instrument—to begin all over again as it were. If it enters and is rather tightly grasped the next sound to be passed should be but one size larger. But if the first instrument is not tightly grasped one may skip several sizes, sometimes three or four with advantage. It is much wiser not to pass more than three sounds on any one day. These should be passed with the utmost gentleness and it is quite true that they should engage by their own weight though they may have to be directed through the stricture. There is no advantage in leaving the sound within the grasp of the stricture for more than a moment.

Bougies are used up to about 20 F sounds to 20 F.

After the stricture has been so dilated that the sound enters readily without being tightly grasped or without exciting hemorrhage the interval between instrumentations is lengthened from one to two weeks then to a month to three to six months on condition that the stricture shows no tendency to recontract. Therefore the dilator must be introduced to celebrate New Year's day and the Fourth of July for the rest of the patient's life, if the stricture is in the bulb.

Operative Treatment of Stricture—*Indications for Operation*—The failure of dilatation is the only excuse for operation upon urethral stricture. This failure may be of several kinds.

Stricture of the meatus can never be dilated we know beforehand that dilatation will fail and we operate accordingly.

Stricture of the pendulous urethra is amenable to dilatation only when the scar has not become fully organized. Tight stricture or dense stricture or stricture that is palpable as a thickness of the corpus spongiosum may be dilated up to a certain point, but must be cut in order to be cured.

Stricture of the bulbous urethra on the other hand if of gonorrheal origin and not complicated by retention or peri-urethritis, may usually be controlled by dilatation. But if the stricture cannot be dilated or if it persistently relapses in spite of intelligent treatment or if retention or infection of kidney, prostate or peri urethral tissue require drainage which dilatation does not afford then operation (external urethrotomy) is indicated.

Peri urethritis always requires operation and a stricture that remains impassable or proves rebellious in the course of dilatation should be operated upon as soon as the patient's consent can be obtained.

Choice of Operation—For strictures of the meatus, meatotomy. For strictures of the pendulous and scrotal urethra, internal urethrotomy.

If the filiform fails to enter the stricture, several alternatives present themselves. The instrument may be withdrawn and tried again, after a different angle has been given to its point, or filiforms with larger or smaller bulbs may be tried, or one may fill the urethra with filiforms, and push in first one and then another, in the hope that one of them may enter the stricture or the urethra may be distended with oil and a single filiform slipped between the fingers that pinch the meatus to retain the oil.

If these maneuvers fail, and if the stricture is a relatively narrow band down to the face of which a urethroscope can be introduced, one may attempt the passage of filiforms through the urethroscope guided by the eye. Young speaks highly of this procedure, but I have had small success with it.

In quite a number of instances, having failed to introduce a filiform, I have succeeded in passing a 10 F steel sound (with the Van Buren curve), but this instrument must be employed with the greatest imaginable gentleness, otherwise the sharp point of the sound will perforate the scar and produce a false passage.

If no complications ensue, the gentle attempt to pass instruments may be repeated day after day for several days, until the patient's and operator's patience are exhausted. But the appearance of any complication, such as fever, retention, or peri-urethritis, usually calls for immediate operation.

In the absence of such complications there is no limit to the number of attempts that may be made to pass a stricture with filiform, but it is probable that the patient's interests will be best served by prompt operation after the failure of two or three attempts at instrumentation.

But before this final decision is reached the physician should once again try to pass a 20 F sound into the stricture to be sure that, after all, this cannot pass. Thereby he will perhaps be saved the mortification later of passing a sound after the anesthetic has been administered.

When a filiform finally has been passed, after many fruitless efforts, one is tempted to tie it in to act as a guide for further dilatation. There is no objection to this, but unless followers have failed to pass, the tying in of a filiform is unnecessary.

Subsequent Dilatation — If the stricture has been satisfactorily dilated by filiforms and followers, no further attempt at instrumentation should be made (unless retention demands it) until the fourth or fifth day, then the same procedure as before should be followed, the first instrument used being chosen with relation to previous experience. At this second instrumentation it is prudent not to attempt to dilate the stricture much wider than at the preceding sitting. Thus, if the first dilatation was to 10 or 12 F, 10 or 12 F may again suffice, for the object of dilatation of a very tight stricture is to iron out its irregularities rather than to dilate it rapidly. By the third or fourth treatment these irregularities are usually sufficiently smooth to permit dilatation to proceed more rapidly.

perineal section is performed and the urethrotome passed from behind forward

After-treatment—The indwelling catheter is withdrawn on the fourth day. The first instrument is passed between the tenth and the fourteenth day. It is well to begin with a woven bougie of about 16 or 18 F size. This gently dilates the urethral wound and may be followed by a 24 or 26 F bougie or sound. No attempt is made to pass a larger instrument at the first instrumentation.

Thereafter the patient returns for instrumentation every five days and the stricture is dilated to 30 F. As soon as the full size is reached without causing considerable hemorrhage the interval between treatments is increased to two weeks and dilatations are continued at this interval until the wound is healed and the urethritis controlled. This will usually take about three months. The patient is then requested to return after an interval of a year. If at the end of this time the urethritis has not relapsed and the stricture has not recontracted he may be dismissed as cured; otherwise he may require further dilatation or cutting.

EXTERNAL URETHROTOMY WITH A GUIDE.—Instruments Required—In addition to the usual instruments external urethrotomy requires a female catheter (preferably of metal) two or three grooved staffs of different sizes, or if the stricture is known to be too small to admit these filiforms and followers. The groove of all staffs and followers should be as wide as possible so that the knife plunged into the perineum may readily find it. A 30 I rubber tube with a lateral as well as a terminal eye is employed for drainage after the operation.

The Operation—Renal decompensation is so great a factor in the mortality that ether is taboo. The anesthetist's experience will direct his choice of caudal spinal nitrous oxide or ethylene anesthesia.

The patient is placed in the lithotomy position. A grooved staff is introduced into the bladder and pushed downward rather firmly against the perineum which is incised in the midline until the bulbous urethra is opened at a point external to the stricture. The free bleeding from the spongy tissue is disregarded. The edges of the cut mucosa are caught and retracted with clamps and a grooved director inserted into the bladder along the groove of the staff. If there is any question in the operator's mind as to the position of this instrument the female catheter is passed from the wound into the bladder. One is reassured by the jet of urine. If this does not flow the staff is kept in place until further probing locates the posterior urethra. This must be located before the staff is removed lest the operator become lost in the perineum and require suprapubic section and retrograde catheterization to identify the canal.

The urethral staff is then withdrawn and using the grooved director as a guide the stricture is incised until it will admit a 30 F whistle-tip tube. Care must be taken that the incision only divides the scar. The posterior urethra must be respected. Accessible hard scar tissue is cut away sparing the urethral roof and the tube tied in by a silk

upon the roof of the canal For strictures of the bulbous urethra, external urethrotomy

Choice of Anesthetic — For meatotomy, local infiltration For internal urethrotomy, surface anesthesia or caudal For external urethrotomy, caudal anesthesia

MEATOTOMY — The asepsis is as for any operation

Using the finest needle, a few drops of anesthetic solution are injected into the floor of the urethra at or beyond the point of greatest constriction

The constriction is then divided on the floor of the urethra until a 28 F bulb can be freely introduced The meatus is then held upon while the straight needle attached to an atraumatic chromic gut suture is introduced from within outward through mucosa and skin at the deepest point of the cleft just to one side of the midline A second similar suture catches mucosa to skin opposite the first one Two or three more such sutures may be needed to close gaps

The wound is protected with sterile gauze for twenty-four hours It does not become infected Bleeding is insignificant The sutures act as foreign bodies to keep the wound open They fall out within two weeks We have seen no complications

INTERNAL URETHROTOMY — *Instruments Required* — Of the many types of urethrotomes the Otis is the best suited for those strictures that will admit it, while tighter strictures may be cut by the Maisonneuve Appropriate sounds to measure the resulting urethral caliber and an indwelling catheter are needed

The Operation — Asepsis of instruments, operator and operating field is carried out as for a major operation

The stricture or strictures have been previously located and calibrated

The Otis urethrotome is passed into the grip of the stricture and about 2 cm farther, its knife pointed toward the roof of the canal This places the dial upside down, yet it ensures against cutting too deeply, for a deep cut on the roof merely enters the septum between the corpora cavernosa, while a similar violation of the floor or sides of the canal would open the peri-urethral cellular tissue and result in abscess The urethrotome is now screwed up to about 34 F and the knife slowly withdrawn until it is felt to jump through the strictured portion of the urethra The urethrotome is then immediately screwed down to its smallest size and withdrawn A 29 F sound is passed to the bulbous urethra, *but no further*

If after the cutting the sound does not pass freely, a second cut upon the roof may be made The meatus may be cut by turning the instrument over and cutting on the floor at this point If after the division of the first stricture other unsuspected points of constriction are found, these must be cut until a 29 F sound passes freely into the bladder An indwelling catheter is then inserted, to be removed after four days

If the stricture is too small to admit the Otis instrument the Maisonneuve may be employed, followed by the Otis If it is impassable,

what might be termed the lower surface of the corpus spongiosum) than would be supposed

If the orifice of the stricture is not found the bulbocavernosus muscle is cut and stripped away from the bulb (if more room is needed the superficial tissues may be divided in V-shape) When the bulb has been freely exposed by good retraction of the superficial tissues it is deliberately but not deeply cut transversely posterior to the point where it has been divided longitudinally in the vain search for the orifice of the stricture At some point the blue mucosa will again be encountered and from this point the passage into the posterior urethra with filiform and grooved director is easy

The surgeon who should fail by either device is thereby proved so unfamiliar with the perineum that he had better make no further attempt to find the urethra at the apex of the prostate but rather take refuge in suprapubic incision of the bladder and *retrograde catheterization* by a Beniqué sound passed through the bladder and thence into the posterior urethra The floor of the urethra is incised upon the point of this instrument and the remainder of the operation concluded in the usual manner

Other Devices for Finding the Orifice of the Stricture—Various other methods have been employed to find the way through the stricture. Thus we may mention the Wheelhouse staff which is no longer used, and Young's suggestion that we identify the apex of the prostate through the V-shaped prerectal incision upon the membranous urethra and work backward from this into the stricture Any surgeon skilful enough to perform this operation could much more readily enter the stricture by the method described above.

RESECTION OF THE URETHRA—The urethral mucosa grows with such amazing rapidity and covers such incredibly large gaps that even when the removal of dense scar tissue about the urethra leaves a wide defect no epithelial graft is necessary so long as the roof of the canal is intact. Indeed such grafts rarely take Sections of the saphenous vein have been employed to take the place of portions of the urethra but the epithelium does not live.

After external urethrotomy for a dense stricture whether this be gonorrheal and in the bulb or traumatic and in the membranous urethra cicatrization may be accompanied with enough scar formation to occasion recurrence of a stricture just as dense as rebellious to dilatations, as liable to pocketing and periurethral abscess as the original lesion (To this the surgeon's clumsiness and the patient's carelessness may contribute.) To prevent this various resections of the urethra have been advised The operations of Cabot and of Pastreau have given us excellent results the former for gonorrheal the latter for traumatic lesions (q. r.) The aim of Cabot's operation is to excise the stricture upon the floor of the urethra in the usual manner and to reunite the longitudinal incision by transverse suture thus puckering the urethra, as it were and enlarging the lumen of the stricture

The steps of the operation are as follows The urethra is steadied by

worm-gut suture that includes a wide grip of the perineal muscles and is wound two or three times around the tube without perforating it

Before tying the tube in the wound the bladder is irrigated with 1 to 4000 silver nitrate solution. The eye of the tube placed about 2 cm within the internal sphincter

The finger should not be introduced into the posterior urethra. Any appropriate exploration should be made by urethroscope or cystoscope

The wound is left wide open about the tube to prevent pocketing. Arteries are tied but bleeding from the corpus spongiosum is disregarded. No gauze packing may be used for the removal of this is likely to excite profuse secondary hemorrhage

Dressings are applied with a two-tail T-bandage. After the patient is returned to bed the patency of the tube is again tested and low decompression applied if there is renal deficiency

Fluids are forced, 4000 cc a day until the renal function is reestablished. We start with a 1000 cc hypodermoclysis of 5 per cent glucose solution

Only hot water is permitted by mouth until the stomach is settled

The perineal tube is removed or exchanged for a much smaller one on the fourth day. Sounds are passed on the tenth day (24 F) and thereafter every fifth day (28 F). The first sound may be guided by a grooved director in the perineal wound

The complications to operation are similar to those encountered in prostatectomy

EXTERNAL URETHROTOMY WITHOUT A GUIDE — If after the patient has been anesthetized no sound or bougie, large or small, or even filiform, can be introduced into the stricture, about 20 cc of 0.5 per cent solution of methylene blue is injected into the urethra and patiently milked through the stricture and into the bladder (I have never known the coloring matter not to enter the bladder unless there was an open fistula or a peri-urethral abscess). The excess of solution is then permitted to escape and the anterior urethra washed out, so that no excess of coloring matter shall remain to soil the wound when the urethra is cut open

The patient is then put in the lithotomy position and as large a staff as the urethra will admit is passed to the face of the stricture in the perineum. The urethra is incised upon this, layer by layer. The mucosa is readily identified and grasped on each side by artery clamps. The staff is withdrawn. Now comes the delicate part of the operation

The wound in the urethra and in the superficial tissues must be wide enough to permit the canal to be drawn almost flush with the perineal skin. The clamps are now steadied and the operator closely inspects the urethra, inserts a probe to its deepest point, and gently incises the floor of the urethra upon this. By the aid of further pairs of clamps the whole of the urethra and the face of the stricture are laid out flat before the operator. He now searches every corner of this surface for the orifice of the stricture with the point of a filiform bougie. It will usually be found much nearer the posterior angle of the wound (and

every pocket even though it be carried to the axilla. One is only cutting skin and subcutaneous tissue. At this first operation every pocket must be opened to its depths and as much as possible of the gangrenous tissue cut away though no time should be wasted over this for the sloughs come away freely through the wide open wound. The initial incision is in the midline of the perineum, from which branching incisions run if required to the groins, thence to the ribs or across the pubes, to the buttocks, etc. Multiple incisions should never be employed. The patient's life may depend upon the immediate relief of absorption. A patient of mine died because the operator having made an incision extending from the anus to the tip of the twelfth rib left an overhanging flap there. No sutures. Forced fluids, stimulation sedatives. Continuous intravenous saline and glucose drip should be employed for the most desperate cases.

The wound takes months to heal. The scrotum shows an unbelievable capacity to crawl over the testicles after about the sixth week. It is generally preferable to defer plastic operations to the end of the second month.

TRAUMATIC STRICTURE OF URETHRA.

The urethra may be torn punctured or incised in any part of its course. Punctures or linear incisions (*e g* false passages from rough instrumentation tears resulting from the extraction of calculi or foreign bodies bullet wounds urethrotomy incisions, etc.) usually heal without leaving any stricture for unless peri urethritis ensues the scar occupies so small a portion of the circumference of the canal that its contraction does not appreciably encroach upon the lumen.

The types of injury likely to result in stricture are (1) the so-called straddle injury (whereby the membranous urethra is partly or wholly torn across) (2) fracture of the pelvis (with the same result) (3) prostatectomy (which may leave a stricture at the bladder neck) (4) injuries to the erect penis (such as breaking a chordee).

With the postprostatectomy stricture we have no concern here. Of the others it may be said that they contract much more rapidly require operation for their relief much more often and recur after operation with much greater obstinacy than do gonorrheal strictures. Thus among 44 personal cases all appeared within six months of the injuries excepting 4. Although an interval of from five to twenty years intervened in these 4 cases between the trauma and the diagnosis of stricture each one had received more or less treatment during this interval treatment that might have controlled the stricture in some degree. But, as a rule traumatic stricture from whatever cause, defies such casual treatment and contracts very rapidly. Among 28 accurately described cases 23 were impassable or filiform in size the other 5 had contracted to 10 16 17 18 and 24 k. Of 44 cases, 31 were operated upon by us others elsewhere. Obviously traumatic stricture contracts much more obstinately than gonorrheal stricture.

a sound instead of a staff. The bulb is exposed in the usual manner but not incised. The bulbocavernosus muscle is stripped away and the bulb itself separated from the corpora cavernosa for a space of at least 3 cm. The bulb is now opened over the point of the sound and the stricture incised or excised in such a manner that the urethra is opened for a short distance behind as well as in front of it. Beginning at the tightest point of the stricture (*i. e.*, approximately at the middle of the longitudinal incision in the bulb) the adjacent edges of the mucosa and underlying corpus spongiosum are sutured transversely with fine chromic catgut introduced on a curved intestinal needle. A small sound is left in the urethra while successive sutures are taken in each side and clamped, but not tied, until the whole wound has been caught in sutures each one running from before backward and closing the wound transversely on the sound in the urethra. The sutures are then tied, beginning with the ones first introduced and ending with those central ones that approximate the anterior and posterior ends of the original incision. Drainage is provided by a small catheter introduced into the urethra by a separate puncture at a point posterior to the incision in the stricture. The perineum is sutured over the incision in the urethra, the small catheter left in place for two weeks, the bladder irrigated daily. Cabot advises daily gentle injection of argyrol into the anterior urethra. We have thought that the trauma from this did more harm than the antiseptics did good.

Cabot's operation is applicable only to relatively narrow strictures. In 7 or 8 cases it has given us better results than simple urethrotomy, but the urethra is much puckered by the operation and one must be extremely gentle in the first attempts to introduce sounds.

RESECTION OF FISTULÆ—External urethrotomy for stricture may be complicated by peri-urethritis, fistula, etc., or by masses of scar left by ancient peri-urethritis. The following rules should guide the operator, *viz*:

- 1 The main incision should be in the central line of the perineum, no matter how many accessory incisions are required.

- 2 Fistulæ must be widely opened to their ultimate ramifications. A pocket in the perineum will not heal.

- 3 Scar tissue must be excised, even though this sacrifice the urethral wall. But every effort must be made to leave an even roof to the urethra as a guide to sounds.

- 4 If the urethra has been completely divided its roof may be repaired as well as possible and its floor left wide open so that subsequent sounds may readily enter the posterior segment or a Pasteau resection (p. 393) may be done.

- 5 In order to avoid subsequent fistula the perineum must be reconstructed as well as possible.

- 6 Fistula of the penile urethra, due to stricture cannot be cured.

DRAINAGE OF PERI-URETHRAL PHLEGMON (OR ABSCESS)—The operation for phlegmon or gangrene is an emergency one. Immediate incision is required and this incision must extend to every corner of

sounds a few weeks after operation. They were promptly put in the hospital the stricture re-incised and thereafter the case presented no unusual difficulties. Such patients we have had under control for as long as ten years. They need rather more frequent dilatation than gonorrheal patients, but they are just as controllable and once the operative wound has healed and the stricture takes a full-sized sound its resilience is usually conquered.

Pasteau's Operation—But the stricture may recontract viciously after repeated external urthrotomies. Such cases may be relieved by Pasteau's operation which consists of excision of the scar and perineal urethrostomy of both cut urethral ends. The patient thus urinates through his perineum and is left in this condition for at least six months, while both segments of the urethra are kept well open with sounds. Then the second stage of the operation is performed (a) Suprapubic drainage (b) sound threaded through both urethral segments into the bladder (c) sufficient flap circumscribed about the two orifices to turn in closing the urethra (d) deeper tissues well freed on either side so as to build up a perineum over the new urethra (e) withdraw sound (f) leave skin widely open for drainage.

CONGENITAL STRICTURE OF URETHRA.

Congenital narrowing of the urethral lumen may be very considerable and yet cause no symptoms. Hence the pathological condition must be distinguished from the clinical. The former must be considered first.

Englisch¹ in his compendious study has collected 165 cases of atresia and 208 of congenital stricture affecting every portion of the urethra for although the urethra is indeed developed from three sources (the posterior urethra from the urogenital sinus the balanitic from an infolding of skin and the intervening anterior urethra from the penile groove) nevertheless congenital stricture may occupy any portion of the canal. It may be membranous or fibrous. A large if not a major proportion of strictures are not associated with other defects of development. The stricture is usually of no great width (in contrast with atresia which may extend over the greater part of the urethra).

The meatus urinarius and the so-called second meatus (a constriction at a depth of about 1 cm. within the urethra) are the usual site of congenital stricture. Indeed in this region it is familiar to all while elsewhere it is extremely uncommon.

The cause of congenital stricture is either maldevelopment or inflammation of the urethra before birth. (Englisch believes that some so-called congenital strictures are the result of non-gonorrheal urethritis in infancy due to balanitis masturbation or the exanthemata.)

Stricture at the Meatus.—Stricture at the meatus occurs in both male and female. It cannot be stretched. Whether congenital or inflammatory it must be divided on the floor of the urethra under

Pathology.—The pathological changes that constitute traumatic stricture are but the scars left by the various types of ruptures in the urethra mentioned above. As Bazy has pointed out, the rupture may be so slight that only the mucosa is torn, but, as a rule, the whole thickness of the urethra has been divided in part or all of its circumference. The typical resulting scar therefore is a narrow one as contrasted with broad, irregular scar of gonorrheal stricture, but it is a dense and elastic scar, contracting rapidly and resisting dilatation.

Symptoms and Course—The chronic urethral discharge (gleet) which is the prevailing symptom of gonorrheal stricture cuts but a slight figure among the symptoms of traumatic stricture. Thus among 21 cases only 2 showed gleet as a first symptom, while 10 complained of frequent and obstructed urination, and 9 of acute retention. In many instances the stricture came on so immediately after the injury that the hematuria which is so prominent a symptom of rupture of the urethra was also the first symptom of the stricture itself. Indeed, the symptoms of stricture usually follow immediately upon those of the rupture. If the injury is so severe that the patient cannot urinate or requires attention for other injuries the urethral rupture is immediately diagnosed, the patient is operated upon, and if properly treated he may be relieved from any symptoms of stricture for a considerable time. Thus weeks, months, and exceptionally years may intervene before the traumatic stricture is diagnosed. But if the injury is only severe enough to cause slight hematuria the patient may not consult a physician, no attempt may be made to treat the condition, and within a few weeks the stricture declares itself by obstructing urination.

The very beginning of traumatic stricture therefore depends largely upon treatment, and its subsequent course is even more dependent upon this. Operation which is not often necessary in the treatment of gonorrheal stricture is almost invariably an essential part of the treatment of traumatic stricture. The stricture must be incised. If it recontracts thereafter it must be incised again. Thus only will its tendency to recontraction be finally overcome.

Treatment—A slight injury to the urethra sufficiently severe to cause hemorrhage should at least be identified by urethroscopy and treated by the passage of sounds according to the rules already laid down. Graver injuries, including almost all injuries to the bulb and posterior urethra, require prompt perineal section and subsequent sounding as a preventive of stricture. Doubtless stricture will follow such operation, but it will be less resilient and intractable than if the operation had not been done.

For the cure of traumatic stricture internal urethrotomy for anterior strictures and external urethrotomy for stricture of the membranous urethra yield surprisingly good results. The failure of one perineal section is no reason why another will not succeed.

On several occasions patients have come to us in despair on account of the recurrence of symptoms or the physician's inability to pass

Chancroid.—This may also leave a scar that constricts the meatus

Bilharzia.—Pfister⁷ states that stricture of the prostatic urethra may result from Bilharzial inflammation. The infection may rarely extend to the anterior urethra and even to the corpora cavernosa.

Stone, Foreign Bodies, and Cancer may obstruct the urethra. They can scarcely be said to cause stricture.

STRICTURE OF THE FEMALE URETHRA.

Stricture of the female urethra whether congenital, traumatic or gonorrheal merits only that its existence be known. Like stricture of the male urethra it is a cause of frequent urination, pyuria, retention. It may be relieved by dilatation or by internal urethrotomy. It is not at all uncommon. Women like men often suffer grave symptoms from strictures of rather large caliber. See also Chapter VIII.

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infiltration anesthesia until a 29 F' sound can be passed freely through it without a hitch. The two edges of the wound are then widely separated and closed with atraumatic chromic gut sutures, as described on p. 386.

Complicating hypospadias, dilatation, and fistula are not uncommon. Tight stricture results in dilatation of the upper urinary tract similar to that which results from retention in later life.

Clinical Types.—1 The tightest strictures, amounting almost to complete atresia, produce enormous renal dilatations which either kill the child at about the time of birth or gravely interfere with parturition because of their size. The stricture is often found in the region of the verumontanum.

2 If the stricture permits the infant to survive, symptoms are often first noted between the fifth and tenth years. Congenital stricture may be suspected in cases of (a) incontinence of urine, especially if this be diurnal, (b) poor nutrition associated with evidence of renal deficiency, (c) unexplained hematuria.

3 The stricture may, however, have so large a caliber that it excites no symptoms until in adult life an intercurrent urethritis calls attention to it. If the urethritis is gonorrheal the true origin of the stricture is, of course, overlooked. Bazy therefore insists that congenital strictures are much more common than we suppose.

4 The stricture interferes with the passage of urethral instruments. Most meatus strictures fall in this category.

Diagnosis.—This is usually made by the exclusion of trauma and gonorrhea (except in the case of meatus strictures).

It has been our good fortune to identify congenital strictures thrice by careful perineal section.

It is difficult to arrive at a clinical criterion as to the exact amount of constriction that constitutes a congenital stricture. Certainly only those strictures require attention that cause retention, interfere with the cure of urethritis or prohibit the passage of urethral instruments. Doubtless it is fair to consider any meatus stricture tighter than 26 F' a potential, if not an actual, cause of chronicity in urethritis.

Treatment.—Engelsch wisely observes that "the earlier the obstacle develops, the more extended are the alterations of the urinary tract higher up." He believes that treatment by dilatation is often useful. Stricture of the meatus will not dilate. It must be cut. All the deeper congenital strictures we have recognized have required operation.

OTHER TYPES OF STRICTURE OF THE MALE URETHRA

Tuberculosis.—Tuberculosis of the prostate results in dysectasia of the bladder neck.

Tuberculosis of the anterior urethra⁸ is scarcely to be classed as stricture.

Syphilis.—The scar of gumma about the meatus may cause stricture. The existence of syphilitic stricture of any importance elsewhere in the urethra is doubtful.⁹

SECTION III

DISEASES OF THE SCROTUM AND TESTICLE

CHAPTER V

ANATOMY AND PHYSIOLOGY MALFORMATIONS INJURIES AND TORSION OF THE TESTICLE

By GEORGE GILBERT SMITH M.D. F.A.C.S.

THE TESTICLE AND EPIDIDYMS

Embryology—The testicles develop during the first third of fetal life. Each testis appears first as the genital ridge upon the ventromesial border of each Wolffian body (Fig. 212). Peritoneal infoldings give rise to solid cords of cells which extend inward from the peritoneal surface of the genital ridges to connect with the glomerular capsules of some of the Wolffian tubules (Fig. 213). Before reaching the glomeruli these cords which later acquire lumina form a net of anastomosing tubules which becomes the *rete testis*. Of the Wolffian tubules, ten to fifteen are utilized in this way. The glomeruli atrophy and the tubules become coiled canals which form the *ductuli efferentes* in the *globus major* of the epididymis. The Wolffian duct, into which they empty, persists as the *ductus epididymidis* and its continuation the *vas deferens*. Of the Wolffian tubules not utilized in this way, one or more may persist as very small pedunculated bodies springing from the *globus major* or from the upper pole of the testicle. The *organ of Giraldes* or *paradidymis* is thus explained; the *hydatus of Morgagni* is said to be a remnant of the duct of Müller. (In the female the duct of Müller becomes the Fallopian tube.) One or more of the lower Wolffian tubules may persist as aberrant ducts leading off the *ductus epididymidis* in the *globus minor*²¹ (Fig. 214).

Descent of Testicle.—As the testicle takes definite shape a fold of peritoneum develops, extending from the lower pole of the testis downward and outward across the iliac fossa. In the free border of this fold develops the gubernaculum, a cord of connective tissue in which are found smooth muscle fibers, supposedly derived from the muscles of the abdominal wall²². Inferiorly the gubernaculum has attachments in Scarpa's triangle to Poupart's ligament, to the pubic bone, to the root of the penis, to the perineal fascia and ischium, and to the bottom of the

scrotum.²² As the lumbar spine grows the testicle is left behind so to speak and thus begins its descent. Whether further descent comes about through the same means—that is by the body growing away from the testicle—or whether the gubernaculum shrinks and exercises an active pull is not known. The fact remains that by the sixth month the testis is at the internal inguinal ring drawn down by the gubernaculum.

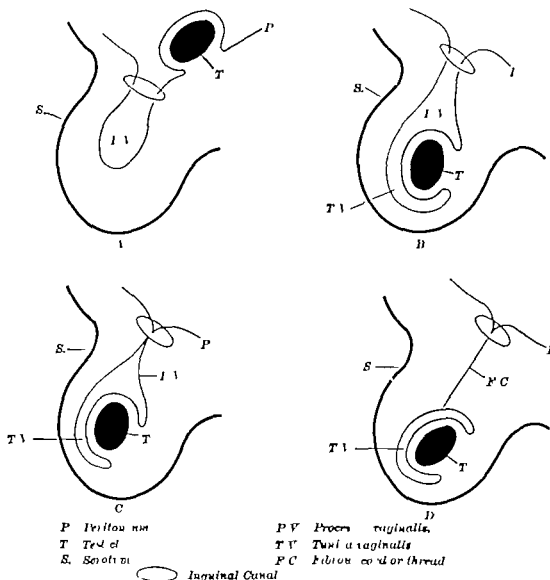


FIG. 215.—Diagram of the descent of the testicle (Watson and Cunningham.)

naclum and connected with its place of origin by the spermatic vessels. The vas deferens, the lower end of which is now attached to the prostate, is drawn outward and downward, passing in front of the ureter and hooking over it.

During their descent the testicle and epididymis have been surrounded by peritoneum except where the membrane is reflected off the

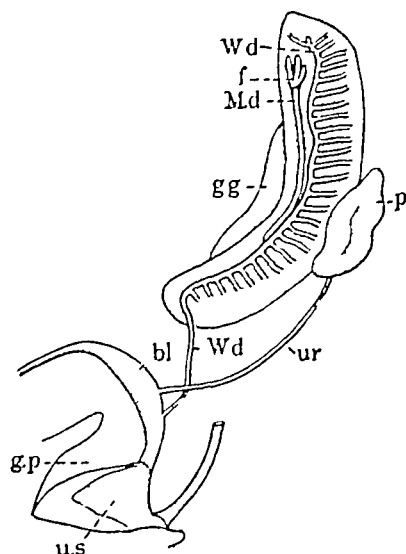


FIG 212 —From a reconstruction of a 13.6 mm human embryo (F W Thyng) *bl*, bladder, *f*, fimbriae, *gg*, genital ridge, *gp*, genital papilla, *Md*, Müllerian duct, *p*, renal pelvis, *r*, rectum, *ur*, ureter, *us*, urogenital sinus, *Wd*, Wolffian duct (Lewis and Stöhr)

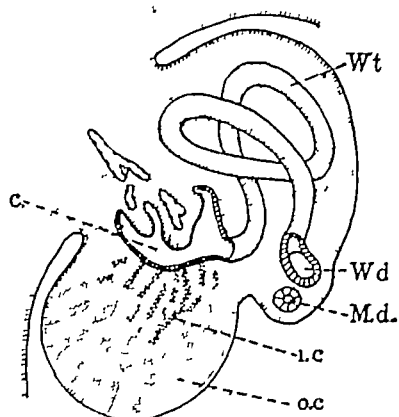


FIG 213 —Diagram of the development of the testis, based upon figures by MacCallum and B M Allen *c*, glomerular capsule, *lc*, inner or sex cords, *Md*, Müllerian duct *oc*, outer or rete cords, *Wd*, *Wt*, Wolffian duct and tubule (Lewis and Stöhr)

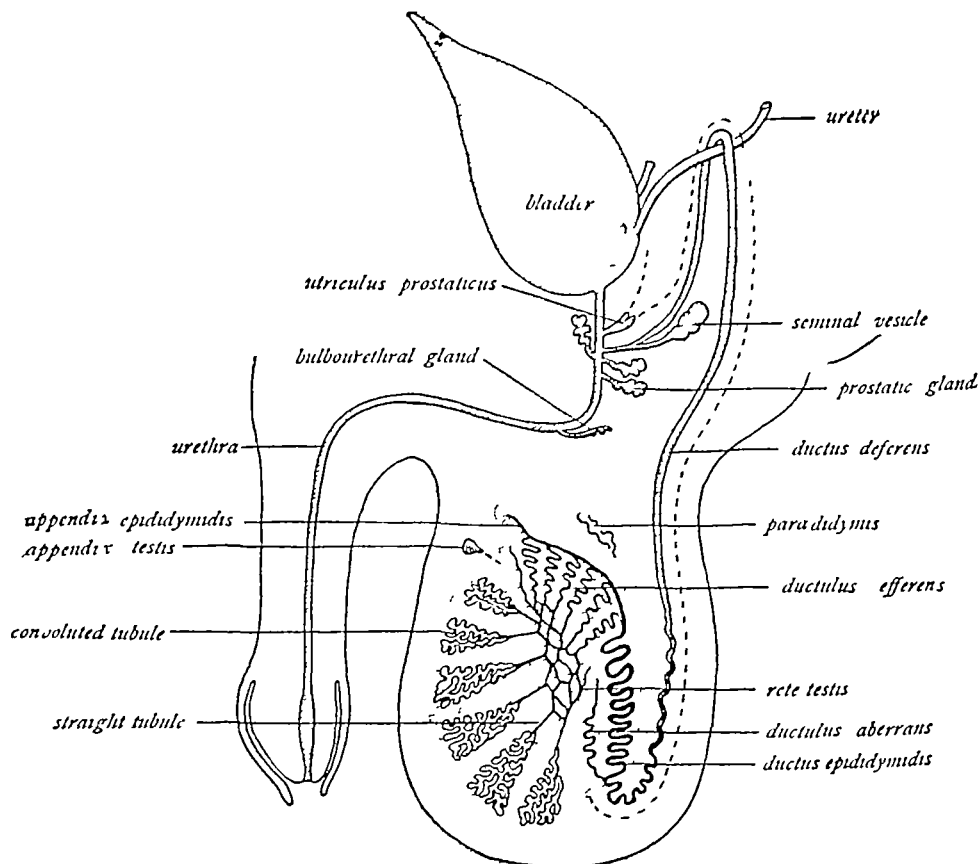


FIG 214 —Diagram of the male sexual organs (Modified from Eberth, after Waldeyer) The course of the Müllerian duct is indicated by dashes (Lewis and Stöhr)

The spermatic cord, which contains the blood vessels of the testis, enters that organ at a point on the posterior superior border mesial to the epididymis.

Arising from the groove between the globus major and the testicle is a fairly constant structure the appendix testis, or hydatid of Morgagni. This has been found in 90 per cent of testes examined and is a pedunculated tumor consisting of vascular connective tissue and containing fragments of canals lined with simple columnar epithelium sometimes ciliated.²⁷ It is thought to represent the Müllerian duct. Attached to the globus major of the epididymis is the paradiidymis or organ of Curaldès.

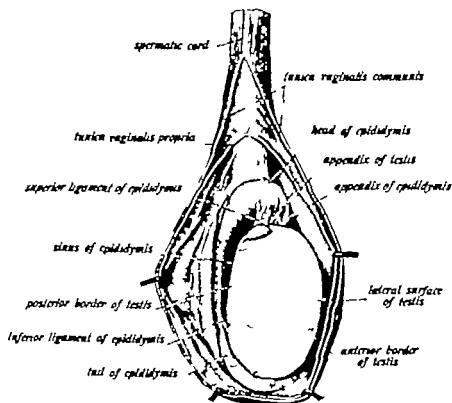


FIG. 217.—The testis and epididymis with their investing membranes, seen from the lateral surface. (Sobotta.)

The *tunica vaginalis* which lines the cavity in which the testis and epididymis are contained consists of a parietal portion and a visceral portion. The parietal layer extends for some distance above the testis and the space which it lines is considerably larger than the organs contained therein. The testis and epididymis are completely invested by the visceral portion save at the points of contact between the two at the posterior border of the testis where the spermatic cord is attached and at the inner posterior aspect of the epididymis.

The attachment of the testis to the scrotum at this point is frequently called the mesorchium. As Rigby and Howard²⁸ have pointed out, the mesorchium properly speaking lies between testis and epididymis and

epididymis A diverticulum of the peritoneal cavity, the *processus vaginalis*, has preceded the testis into the scrotum The testicle enters the inguinal canal, passes out through the external ring, and at birth or shortly after reaches its position in the scrotum The peritoneal canal then becomes obliterated in its upper part, leaving the lower part to form a serous sac for the testicle (Fig 215)

ANATOMY OF THE TESTICLE.

The testes are a pair of somewhat oval, slightly flattened bodies of a grayish-white color, measuring about $1\frac{1}{2}$ inches in length, 1 inch from before backward, and rather less in thickness ¹⁶ As the testicles hang in the scrotum the long axis is directed upward, slightly forward and outward (Figs 216 and 217)

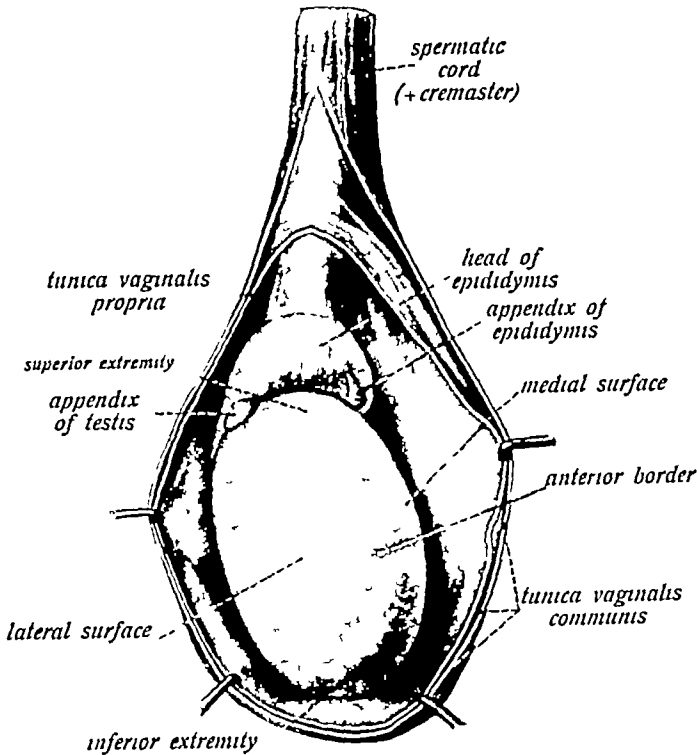


FIG 216 —The testis and epididymis, with their investing membranes, seen from in front (Sobotta)

The posterior border of the testis bears a crescentic body, the epididymis The upper extremity of the epididymis, or globus major, lies upon the upper pole of the testis and is enveloped by a serous covering except at its attachment to the testicle The body of the epididymis is applied against, but is separated from the testis by an infolding of the serous covering of the organs, which forms an intervening pocket termed the digital fossa The lower and smaller extremity, or globus minor, is attached to the testis only by connective tissue and by the serous covering From the globus minor the vas deferens proceeds upward in the loose tissue outside the serous sac

The spermatic cord which contains the blood vessels of the testis, enters that organ at a point on the posterior superior border mesial to the epididymis.

Arising from the groove between the globus major and the testicle is a fairly constant structure the appendix testis, or hydatid of Morgagni. This has been found in 90 per cent of testes examined and is a pedunculated tumor consisting of vascular connective tissue and containing fragments of canals lined with simple columnar epithelium sometimes ciliated.²² It is thought to represent the Müllerian duct. Attached to the globus major of the epididymis is the paradidymis or organ of Curaldès.

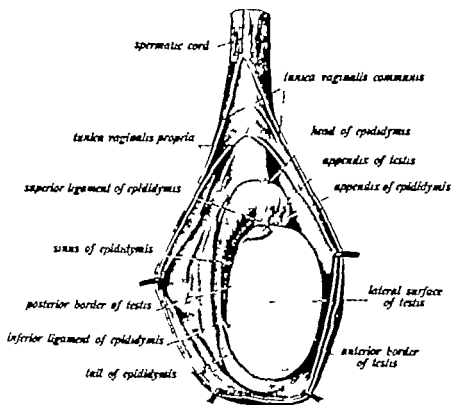


FIG. 217.—The testis and epididymis, with their investing membranes, seen from the lateral surface (Robotta.)

The *tunica vaginalis* which lines the cavity in which the testis and epididymis are contained consists of a parietal portion and a visceral portion. The parietal layer extends for some distance above the testis and the space which it lines is considerably larger than the organs contained therein. The testis and epididymis are completely invested by the visceral portion save at the points of contact between the two, at the posterior border of the testis where the spermatic cord is attached and at the inner posterior aspect of the epididymis.

The attachment of the testis to the scrotum at this point is frequently called the mesorchium. As Rigby and Howard²³ have pointed out the mesorchium properly speaking lies between testis and epididymis and

is usually short, the attachment of testicle and epididymis to the scrotal wall should be called the *urogenital mesentery*

Finer Structure.—**Testis** —The testis is enveloped in a tough fibrous coat called the *tunica albuginea*. At the point of entrance of the spermatic vessels this becomes thicker and forms the *mediastinum*, or *corpus highmori*. The inner layer of the tunica albuginea is very vascular, and from it spring fibrous septa which, passing to the mediastinum, divide the testis into some 200 cone-shaped lobules. Each of these contains three or four seminiferous tubules, which can be unravelled and appear to the naked eye like fine threads. They unite to

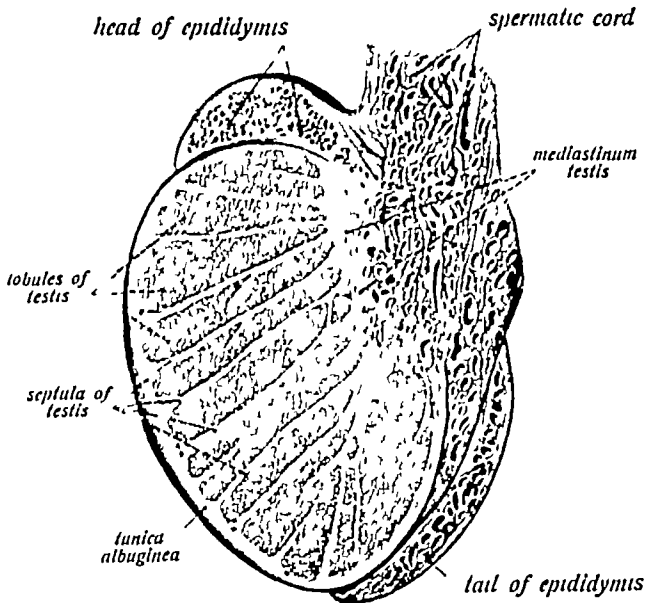


FIG. 218 —Longitudinal section of the testis and epididymis (Solbotta)

form a smaller number of straight tubules, the *tubuli recti*, and these in turn open into the *rete testis*, a complicated network of canals occupying the mediastinum (Fig. 218).

Epididymis —From the rete testis some fifteen or twenty ducts, so coiled as to present cone-shaped masses with their apices toward the testicle, carry the secretion to the main duct of the epididymis. The smaller ducts are the *vasa efferentia*, the single duct is the *ductus epididymidis*. About 20 feet long when unravelled, this duct comprises the body and lower pole of the epididymis, and leaves it as the *vas deferens* (Fig. 214).

Histology of the Testicle.—Aside from the connective-tissue framework, three kinds of cells occur in the testis. Two of these are found in the seminiferous tubules—the *sustentacular* or supporting cells, often called the cells of *Sertoli*, and the *sexual cells* (Fig. 219). The latter may appear in any one of the five stages through which they must pass before becoming mature spermatozoa. (See Physiology of the Testicle, p. 406.) The sustentacular cells extend from the basal membrane of the tubules

toward the lumen. Early in life they form a syncytium, later as spermatogenesis takes place they become cylindrical in shape with an outline made irregular by the pressure of the sexual cells which develop

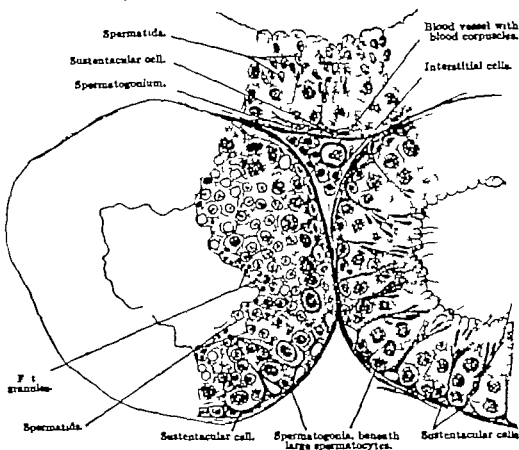


FIG. 219.—Cross-sections of seminiferous (convoluted) tubules of a mouse $\times 300$ (Lewis and Stohr)



FIG. 220.—Cross-section of a convoluted tubule of the testis at birth. (Eberth)

FIG. 221.—Sustentacular cells. *a*, isolated (Kolliker) *b*, Gold preparations. (Böhm and von Davidoff)

between them (Figs. 220 and 221). Each cell has an ovoid nucleus with a distinct nucleolus; the protoplasm contains fat droplets, brown granules, and at times crystalloid bodies in pairs.²³

The third kind of cell, the *interstitial* cell, or cell of Leydig, occurs in the loose connective tissue between the tubules. These cells are derived from the mesothelium of the genital ridge,⁷⁷ they are usually round or polygonal in shape, without distinct cell boundaries. Their protoplasm contains pigment and other granules, fat droplets, and rod-



FIG 222 — From a longitudinal section through a convoluted tubule of a human testis
 $\times 360$ (Lewis and Stöhr)

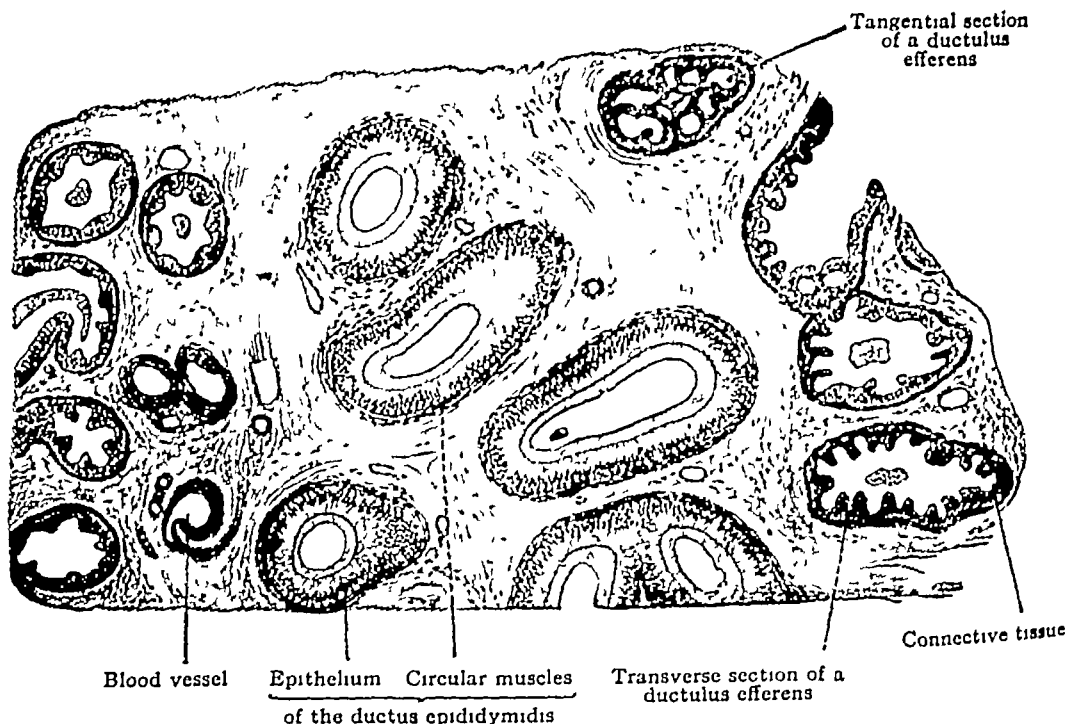


FIG 223 — From a section of the head of a human epididymis, showing sections of the ductus epididymidis in the center and of ductuli efferentes on the sides $\times 50$ (Lewis and Stöhr)

shaped crystalloids. During fetal life (Fig 222) the interstitial cells are relatively abundant, after birth they rapidly diminish and are not much in evidence until puberty, when they undergo a renewal of growth and remain constant. After puberty they recede somewhat until senile changes set in, when they again increase.

Histology of Epididymis —The epithelium of the convoluted tubules of the testis becomes more simple in the tubuli recti and rete testis and in the *efferent ducts* of the epididymis consists of groups of columnar cells alternating with cuboidal cells. Often the tall cells, and occasionally the short ones, are ciliated. The efferent ducts have a circular coat of smooth muscle fibers containing elastic fibers. The *ductus epididymidis* is lined by a two-rowed epithelium with rounded basal cells and tall outer columnar cells. The latter have in the middle of their upper surfaces long non-motile hairs. A thick circular muscle layer surrounds the ducts (Fig. 223).

The *vas deferens* at the epididymal end is lined with two-rowed ciliated epithelium and is surrounded by three layers of smooth muscle: the inner and outer longitudinal, the middle layer circular (Fig. 224).

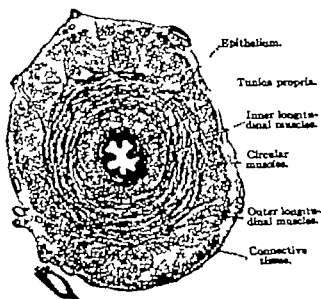


FIG. 224 — Cross-section of the human ductus deferens. $\times 24$ (Lewis and Sistrup)

Blood Supply of Testicle and Epididymis. —The chief artery of the testis is the *internal spermatic* which is given off the abdominal aorta just below the renal arteries, supplies a branch to the ureter as it crosses, and passes with the spermatic cord through the inguinal canal to the testicle. Before entering the testis it gives a branch to the *globus major* of the epididymis. The main stem then passes into the mediastinum where it breaks up into many branches. These reach the parenchyma through the tunica vasculosa and through the septules and form capillary plexuses around the convoluted tubules. The body and tail of the epididymis are supplied by the deferential artery which adheres closely to the vas deferens until it reaches the epididymis. This artery is a branch of the inferior vesical or sometimes of the superior vesical. A third artery enters the lower pole of the testis or epididymis. This is the *external spermatic funicular* or *cremasteric* artery which is given off the deep epigastric and runs in the fibrous sheath of the spermatic cord.

Picqué and Worms⁶³ have shown that in dogs there is free anastomosis between these three arteries. The exact nature of the anastomosis varies, but in every case of the 24 which they studied, the existence of such a communication was clearly shown. They found no connection between the arteries of the testicle and those of the scrotum.

The veins follow the arteries in the testicle and epididymis. Upon issuing from these organs, they form a plexus, the *pampiniform plexus*. The plexus is part of the spermatic cord, and consists of eight to ten veins, they traverse the inguinal canal, and near the internal ring terminate in two main trunks which higher up unite to form a terminal stem. The right terminal vein enters the inferior vena cava, the left one enters the left renal vein. The spermatic veins are provided with valves both in their course and at their terminations, but occasionally the valve at the orifice of the left spermatic vein is absent.¹⁶

Lymphatics.—The lymphatics which drain the testes follow the spermatic cords and enter the lumbar nodes. These nodes, it will be remembered, also receive the drainage from the kidneys. The lymphatics of the vasa deferentia empty into the external iliac nodes.¹⁶

Nerves.—The nerves for the testis accompany the spermatic artery, and are derived from the aortic and renal plexuses. In the epididymis the nerves form the *plexus myospermaticus*, which is a network in the muscular coat of the ducts, provided with sympathetic ganglia.

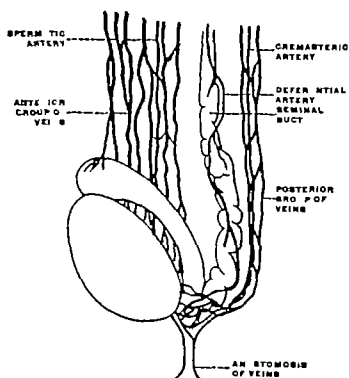
PHYSIOLOGY OF TESTICLE AND EPIDIDYMIS

The testis appears to have two functions. One is concerned with the production and development of spermatozoa, the other has to do with the furnishing to the organism of an internal secretion. The first function is carried on by the cells lining the convoluted tubules, namely, the sustentacular cells and the sexual cells, the second, by the interstitial cells. The function of the sustentacular cells is to support and nourish the sexual cells during their development. Fig 221 shows several spermatozoa with their heads embedded in the protoplasm of a sustentacular cell. It has already been mentioned that these cells abound in fat. Von Ebner⁷¹ has described a circulation of this fat from the base of the sustentacular cell toward the lumen of the tubule, during the course of a spermatogenic generation. As the spermatozoa developed, the fat diminished. Hanes and Rosenbloom²⁰ have shown that the testes from cryptorchid pigs, in which there is very little spermatogenesis, contain an excessive amount of fat, and they have also shown that as the fat passes toward the lumen of the tubule, it changes from a neutral fat to a lipid.

No further function of the sustentacular cells has been demonstrated.

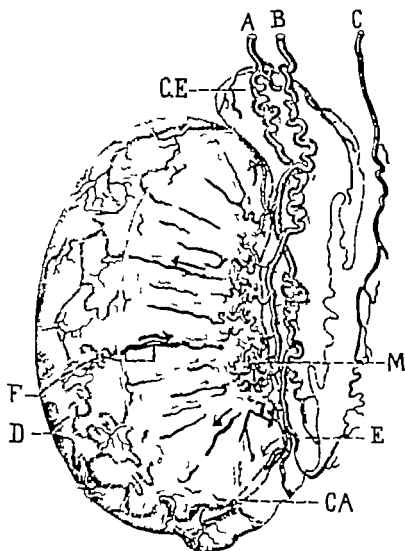
The sexual cells undergo a transformation which is called "spermatogenesis." The cells pass through five phases. (1) The *spermatogonia*, or mother cells, lie nearest the basal membrane of the tubule. (2) Above them are the primary spermatocytes, which are larger, their nuclei usually show spindles or other indications of cell division. (3)

PLATE VII



The Arteries of the Testis and the Cord (Gray)

PLATE VIII



Arterial Supply of Human Adult Testis. A Portion of the Gland has been Removed so as to Show the Penetration of the Arteries through the Mediastinum into the Glandular Tissue.

A B, main terminal branches to testicle; C branch following spermatic cord and encircling and supplying vas deferens; CA capular artery—a branch from B; CE caput epididymis—shown in outline; D branch of capular artery lying on innermost side of albuginea; E outline of epididymis; F central artery connecting vessels of mediastinum with capular branches; M mediastinum X 31 (HILL)

A circular, high-contrast black and white illustration of a plant, possibly a seed or fruit, showing internal structures like seeds or embryos arranged radially within a textured outer layer. The image is framed by a thick black border. The central area is filled with intricate, branching, and radial patterns, suggesting a complex internal structure or a network of vessels. The overall appearance is that of a detailed botanical drawing or a microscopic view of a plant part.

At ascending artery 11 ascending vein, DA descending artery DV descending vein
M mediastinum, VD vas deferens, TA, tunica albuginea TP tunica parietalis. (Hill)

AA ascending artery; AV ascending vein; DA descending artery; DV descending vein
M mediastinum; VD vas deferens; TA, tunica albuginea; TP tunica parietalis. (Hill)

this point and although he found the condition mentioned by Aristotle B C 350 and a good many times thereafter by other observers he found only 23 cases in which the theory was supported by the presence of vas or epididymis in connection with the alleged extra testicle. It certainly is probable that in many cases the observer was misled by an encysted hydrocele or vestigial tumor which happened to yield testicular sensation when squeezed. Lamb found reports of 6 cases however in which a third testicle was discovered at operation or at autopsy 2 of them were in horses, 1 in a dog 3 in men.

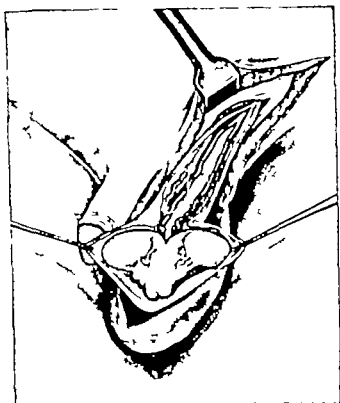


FIG. 226.—Ectopic testis, transverse section.

Lamb himself reported the case of a man examined during life by Lamb and numerous other observers all of whom agreed upon the existence of a third testicle.

Arbuthnot Lane²⁴ removed a third testis from the right side of the scrotum of a boy aged fifteen years. It was the size of a marble, but had no testicular sensation. It had a tunica vaginalis and vas deferens of its own. Microscopic sections were made. The other testis occupying the right side of the scrotum was extruded and seemed normal. The left was not exposed but felt normal on palpation.

Whitehead²⁵ reports the examination of a third testis removed from the abdomen of a horse which had had two testes removed in the usual manner two years before. It seems therefore, that although extremely rare triorchism may occur.

Anorchism.—Jacobson²⁶ credits to the French writers this classification of deficiencies in the seminal apparatus.

responsible for an internal secretion which has considerable influence, to say the least, in the development of sex characteristics

As Pappenheim and Schwartz⁵² point out, lesions of other glands of internal secretion, such as the adrenals and pituitary body, are regularly accompanied by poor development of the sex characteristics, so that the testes alone are not responsible. Pappenheim and Schwartz maintain, furthermore, that the sustentacular cells cannot be excluded, inasmuch as they do not atrophy in many cryptorchids. Whitehead⁷⁷ presents a case which comes near to answering their argument. A stallion was not cured of his sexual desire by the removal of two apparently normal testicles. Two years later a third testis was removed from the abdominal cavity. His desire ceased. The testis on section showed marked increase of the interstitial cells, and atrophy of the sustentacular cells as well as of the sexual cells.

The interstitial cells contain granules which have the same staining reactions as do the granules in the cells of other organs of internal secretion. On the evidence so far presented it seems justifiable to state that the interstitial cells are at least intimately concerned in and necessary for the normal development of the secondary sexual characteristics. There is considerable evidence to show that their existence is essential to sexual desire.

Recent work by Lower³⁹ and his associates has shown experimentally that the internal secretion of the testis, operating through or in connection with the anterior lobe of the pituitary gland, influences to a marked degree the size of the prostate and vesicles. The relationship between the internal secretions of the anterior pituitary and the testis, and their effect upon various parts of the body, is now being studied by numerous investigators. It seems not unlikely that many facts concerning the testicular secretion, some of which will prove to have a clinical application, will be discovered within the next few years.

MALFORMATIONS OF THE TESTICLE.

A	Anomalies in development	Anomalies in number	In excess	Polyorchism	
			In deficiency	<div> <div>Absence</div> <div>Fusion</div> </div>	<div> <div>Anorchism</div> <div>Synorchism</div> </div>
		Anomalies in size	In excess	Hypertrophy	
			In deficiency	Atrophy	
B	Anomalies in descent	Testicle undescended	At some point in its normal course	Retention	
			Outside its normal course	Ectopia	
		Testicle descended	Upside down	Inversion	
			Hind side foremost	Retroversion	

(Adapted from Monod and Terrillon, p. 2)

Polyorchism.—There seems good evidence that cases of more than 2 testes have occurred in man. D. S. Lamb³⁵ reviewed the literature on

Conditions associated with the testis and its component parts

- 1 The spermatic vessels may be too short
- 2 The vas deferens may be of insufficient length
- 3 The testis itself may be of abnormal size as compared with the usual size of the track along which it has to leave the abdomen
- 4 The epididymis may be of abnormal size
- 5 There may be a fusion of the two testes
- 6 Certain forms of hermaphroditism

Conditions associated with the gubernaculum testis

- 1 There may be a deficiency or absence of the lower or scrotal attachments.
- 2 There may be a deficiency of the activity of its muscular fibers
- 3 Possibly even a want of its upper attachments may lead to a fault in descent.

Conditions associated with the cremaster

- 1 A want of action of the internal fibers of the cremaster before the testis has reached the inguinal canal
- 2 A retraction by the action of the cremaster of the testis after it has gained its normal position in the scrotum

Conditions associated with the route along which the testis passes

- 1 An ill-development of the inguinal canal
- 2 An ill-development of the superficial abdominal ring
- 3 An ill-development of one-half of the scrotum

Other conditions not falling under the above headings

- 1 Pressure of a truss for an accompanying hernia preventing the onward passage of the testis from the inguinal canal to the scrotum

In certain cases although the body of the testis proper may be retained within the canal the vas and even the epididymis may descend to a much lower level and can be felt outside the canal²⁶

Incidence—Incomplete descent of the testicle during the first few months of life is quite common. Such in the examination of 143 male infants of from one to four months of age found this condition in 14 per cent. In 60 per cent of these it was bilateral. The great majority of such testicles descend during the first year and a few of the remaining descend during the years before puberty. Odiorne and Simmons²¹ reported 3 cases in which descent occurred at fourteen years of age.

In adults incomplete descent of the testicle is by no means rare. Marshall¹⁸ found 12 cases in 10,800 recruits (0.1 per cent). Hempel²⁷ gathered statistics which showed that in 7,000,000 Austrian recruits 14,000 were so affected (0.2 per cent).

The United State War Department reported that 3.1 per 1000 men examined for the draft showed imperfect descent of the testicle (0.31 per cent).

Accumulated statistics show that the condition is more prevalent on the right side. In the combined series of Coley,¹⁴ Berger,⁴ and Odiorne and Simmons,²¹ totaling 674 cases, 50 per cent were right sided, 30 per cent left sided and 14 per cent bilateral.

- 1 Absence of the testicle only
- 2 Absence of the testicle, the epididymis, and a portion, more or less extensive, of the vas deferens
- 3 Absence of the whole apparatus
- 4 Absence of all or part of the excretory apparatus, the testicle being present
- 5 Bilateral anorchism

Jacobson, writing in 1893, had found recorded 5 cases of absence of the testicle only. The unilateral absence of testis, epididymis, and a portion of the vas was met most frequently, there were but 2 cases recorded of entire absence of the whole seminal apparatus. Absence of the epididymis alone may occur. Gruber, professor of anatomy in Petrograd, writing in 1868, could collect only 23 cases of unilateral and 7 of bilateral anorchism which were verified by autopsy.³²

Synorchism —The fusion of both testicles within the abdomen has been reported by Cruveilhier¹⁵. Their fusion within the scrotum has been reported by von Lenhossék⁷² and by A. E. Halstead²⁴ in whose case the epididymes were fused (Fig. 226).

Hypertrophy and Atrophy —The condition of atrophy of one testicle is not infrequent, and many times no history of a preceding lesion can be found to account for the condition. In some of these cases, the other testicle appears to have undergone hypertrophy.

IMPERFECT DESCENT OF THE TESTICLE.

The descent of the testicle may be stopped at any point. Retention within the abdomen is the least common variety, and, as the testis is hidden from view, the condition is called "cryptorchism." The term is loosely applied to other forms of arrested descent as well. Within the abdomen, the organ may remain in the iliac fossa close to the spine, or may stop just inside the internal inguinal ring. The most usual form of incomplete descent is the "inguinal," in which the testis is retained within the canal. Or the descent may stop just after the testis has emerged from the canal (Cruroscrotal or scrotofemoral retention). The testicle may be movable and change its positions frequently, so that at times it belongs in one group, at times in another.

The cause of arrest of descent of the testicle is not clearly worked out. Certain it is that in operations for this deformity, shortness of the spermatic vessels offers the greatest obstacle to placing the testis in the bottom of the scrotum. Eccles²⁰ mentions a number of conditions which may be factors in producing the anomaly. These are

Conditions associated with the mesorchium

- 1 The mesorchium may be too long. The testis would then hang too freely within the abdominal cavity, and thus be prevented from engaging in the opening into the inguinal canal.
- 2 Adhesions may have formed between the peritoneum of the mesorchium and the adjacent portion of the peritoneum.
- 3 An abnormal persistence of the plica vascularis may unduly tether the testis.



FIG. 228

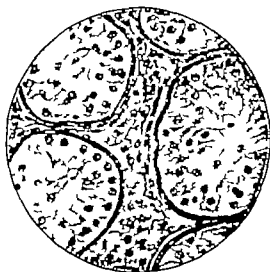


FIG. 229



FIG. 230

FIG. 228.—Section from undescended testicle removed from man of twenty nine years. Position putao. The testicle was soft $\times 1$ cm. in diameter and fastened to the wall of the hernial sac. The greater part of the organ was composed of rather dense fibrous tissue with many small oval nuclei and containing large numbers of Reinke's crystals. There were many interstitial cells. The tubules were scattered irregularly throughout the sections and for the most part were represented by masses of hyaline tissue. This case illustrates the more advanced type of atrophy. (Odiome and Simmons.)

FIG. 229.—Section from an inguinal testicle from a man of twenty three years. The testicle was 3×1.5 cm. in diameter. There was no increase in the fibrous tissue which, however, contained many small areas of interstitial cells. The basement membrane of the tubules was only slightly thickened but they contained only sustentacular cells, no spermatogenic cells being seen in any section. (Odiome and Simmons.)

FIG. 230.—Section from an inguinal testicle from a man of thirty years. The fibrous tissue was increased and contained many interstitial cells. The tubule in the lower part of the field is nearly obliterated by the thickening of the basement membrane. The tubule in the upper part of the field shows active spermatogenesis in the lower portion. (Odiome and Simmons.)

Ectopic Testis —When the testicle, instead of reposing at some point along the usual path of its descent, lies outside that path, the condition is known as *ectopia*. The testicle may become ectopic through violence (see Injuries of Testicle), the condition is then known as *luxation of the testicle*. Congenital ectopia is believed to be due to an abnormal pull exerted by certain fibers of the gubernaculum, associated perhaps with some abnormality of the testis or inguinal canal which hinders proper descent. Constant pressure by an accompanying hernia, especially if further progress is impeded by some abnormality ahead of the testicle, may also be a factor in driving it out of its course (Eccles).

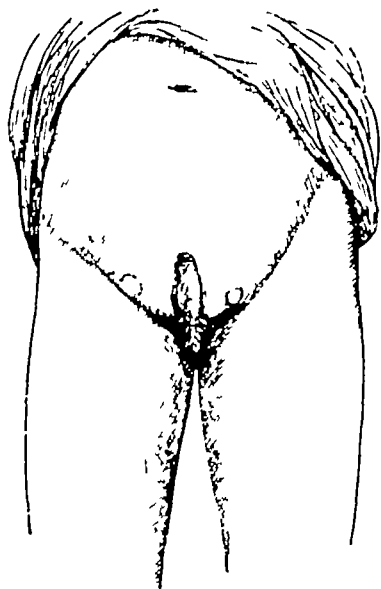


FIG 227 —Inguinal retention, on both sides, in a boy aged twelve years, interstitial sub-variety. The dotted lines indicate the position of the testes. The left is a little lower than the right. The scrotum is ill-developed. (Osborn.)

The varieties of ectopia are

1 Interstitial. The testicle lies peritoneally (Hempel) or in front of the aponeurosis of the external oblique (Fig. 227).

2 Penile. The testis lies in the soft tissues between the root of the penis and the pubes. Two cases have been reported by W. Popow,⁵⁴ and one by J. Poupart.⁵⁵

3 Crural (or Femoral). The testis lies in Scarpa's triangle. Jacobson³² quotes several cases in which the testis left the abdomen by the crural canal. Eccles²⁰ casts doubt upon the accuracy of the observations in such cases, and says that in careful dissections the cord has always been found to lie in front of Poupart's ligament.

4 Perineal. The testis lies in the perineum, the scrotum on the side of the ectopia is usually atrophied. A firm band of tissue holding the testicle to the spine

of the ischium can generally be felt. This is the type of ectopia most frequently encountered, and seems to result in less damage to the testicles than do the other kinds.²⁷

5 Transverse. Both testes descend by the same inguinal canal. Cases have been reported by von Lenhossék,⁷² in 1845, Jordan,³³ in 1885, Berg³ in 1904, and A. E. Halstead,²⁴ in 1907.

Inversion and retroversion of the testis need only be mentioned. The latter condition, in which the epididymis is toward the front, is said by Rigby and Howard⁵⁷ to occur once in every twenty men, a statement which we cannot believe represents the facts.

The Effects of Incomplete Descent upon the Testis Itself —The effects of incomplete descent upon the testis are much the same whether the organ is arrested in its normal path or whether it is ectopic. The exposure of the testicle to the pressure of overlying tissues and to repeated knocks

In elaboration of this theory, these authors call attention to the heat regulatory mechanism of the scrotum its contraction in cold weather brings the testis closer to the body warmth and relaxation in warm weather remove them farther from the source of heat Their theory may also explain the fact that some partially descended testes produce spermatozoa these testes probably are the more movable ones which occasionally emerge from the inguinal canal and are therefore less subject to a constantly high temperature Cooper¹² in a gland situated at the external ring in an adult male found parts showing complete spermatogenesis. Hobday²⁰ found spermatogenesis in testes that remained in the lower part of the inguinal canal but in those found in the upper part of the canal or abdomen this was rare Bland-Sutton¹ found however one case showing complete spermatogenesis in an abdominal testis

An important point in this connection is the condition of the undescended testicle before the age of puberty At what age does degeneration of the spermatogenic function occur? C. Bellinham Smith⁴² examined 6 undescended testes from boys under the age of puberty and found all of them smaller than normal with fewer tubules and more interstitial cells. This condition held even in a testis from a three-year-old boy Rawlings⁴⁴ found that the undescended testes in boys under the age of ten years show no morphological changes but in those examined after puberty it could readily be seen that the organ had not undergone changes incident to puberty Odiorne and Simmons⁴¹ stated that testes though undescended are of normal structure during childhood but undergo none of the normal changes of puberty Cooper found that cell differentiation and spermatogenesis began to develop at about the age of eleven and that at puberty the tubular cells began to show degenerative changes in the retained testis. Complete degeneration he found to be a slow process. Beigel found active spermatozoa in the semen of a man aged twenty two years, with bilateral inguinal retention Odiorne and Simmons demonstrated active spermatogenesis in an undescended testis of a man aged thirty years.

From these observations Cabot and Nesbit¹⁸ conclude that orchidopexy had probably best be performed before the age of nine and that even after puberty and including the third decade the operation may save a gland capable of some spermatogenesis. This position is strengthened by the observations of Moore and Oslund⁴³ that the artificially cryptorchid testes of guinea-pigs will resume their spermatogenic function after reimplantation in the scrotum

In addition to the above-mentioned changes the undescended testicle is likely to be tender and is particularly liable to injury If retained in the inguinal canal the pressure of the fascia as the abdominal muscles contract may be the cause of pain Ectopic testicles of the perineal type are particularly exposed in riding horseback. Those of the penile type suffer during intercourse Undescended testicles are liable to any of the diseases which affect the normal organ perhaps to an even greater

such as a normally descended gland would escape are not the only factors which are known to have a harmful influence¹ The atrophy is probably due to anemia caused by constant pressure upon the circulation in the testis and results in small, soft testicles with disturbed function

In some instances the degenerative changes progress so far that the entire testis becomes a mere fibroma

The fact that the undescended testis is frequently deficient in spermatogenesis has been known for many years John Hunter, in 1791, said that the abdominally retained testis was probably more defective than that arrested along the inguinal canal Monod and Terrillon⁴² in 1879 and Jacobson³² in 1893 referred to the sterility which is frequently associated with cryptorchidism, the examination of such testes showed a degeneration of the spermatogenetic cells and in most cases no corresponding degeneration of the interstitial cells The reason for the degeneration of the spermatogenetic cells was attributed by Crew¹⁴ in 1922 to the difference in temperature between the intra-abdominal or inguinal position and the scrotal position This theory has been thoroughly established by the work of Carl R Moore⁴⁴ and his associates Using rats, rabbits, guinea-pigs and sheep, Moore and Oslund⁴³ reached the following conclusions

1 "A testis of a normal ram, if removed from the scrotum to the peritoneal cavity with the tunica vaginalis intact and spermatic cord uninjured, will lose its germinal epithelium and become a typical cryptorchid testis The germinal epithelium entirely degenerates with the exception of a single layer of cells that remain next the basement membrane (probably largely Sertoli cells).

2 "The interstitial tissue of such an experimentally produced cryptorchid testis does not differ from the normal to any great extent, the Leydig cells appear to be slightly more numerous and the connective tissue a little more prominent than normal

3 "Unilateral vasectomy for seventy-six and ninety days does not produce complete degeneration of the seminiferous tubules and interstitial cell hypertrophy Some tubules are degenerate, apparently from retention of the testicular products producing pressure atrophy

4 "The intertubular tissue of testes with resected vasa deferentia has not been visibly affected

5 "External wrapping of the ram's scrotum for eighty days results in the loss of all spermatozoa and considerable degeneration of the tubular epithelium

6 "A testis in the above degenerate condition, when removed to the peritoneal cavity for seven days, is found to have lost the remainder of the germinal epithelium with the exception of the single layer of cells found always in undescended testes.

7 "We believe that we have demonstrated that an animal can be sterilized by its own body heat and that undescended testes occurring in Nature are undoubtedly degenerate because of the higher temperature to which they have been subjected "

were strangulated. In some cases the hernia occupies a separate sac, or the hernial sac may invaginate the tunica vaginalis as it blocks the inguinal canal. A hernia of such a type is doubtless brought about by the dilatation of the inguinal canal caused by the retained testicle. The testicle may act as a ball valve and bring about strangulation of the hernia or may block its progress through the canal and force it to burrow out between the muscular layers.

Diagnosis.—The differential diagnosis between strangulation of a hernia accompanying an undescended testis and acute epididymitis or torsion of the testicle itself may be difficult, particularly in the first twenty-four hours. A strangulated hernia is less painful locally, but more disturbing generally; the vomiting is more persistent, the temperature normal or subnormal, the abdomen increasingly distended. Torsion of an undescended testicle is most painful at first, the pain decreasing after a few hours. There may be nausea, but the vomiting is not so marked a feature. The temperature is normal or slightly elevated. Locally the tenderness is intense, the swelling only moderate in degree. The overlying skin may be reddened. Clear urine and a negative history of urethritis favor both these diseases, whereas the presence of a urethral infection would make one strongly suspicious of acute epididymitis. If epididymitis is developing, the temperature is likely to be elevated, the testicle is not much enlarged, but is acutely tender. The overlying skin reflects the underlying inflammation by edema and redness. After the first twenty-four hours, the epididymis may be differentiated from the testicle.

Whichever diagnosis is arrived at, there is but one safe course. Operation at once is indicated, not only to relieve the possible strangulated hernia, but to prevent the infection which may develop in torsion or in epididymitis from spreading to the peritoneal cavity through the hernial sac which is almost always present.

Treatment of Undescended Testicle.—To recapitulate briefly, the undescended testicle if left alone is almost sure to cease functioning; it is liable to injury, to torsion, perhaps to tumor growth. The chances are more than even that sooner or later a hernia will develop. In very young children the descent of the testis may be encouraged by gentle massage above and behind the gland (Langenbeck). The use of a forked truss is not advised by Moschowitz.⁴⁷

1. It is Counsellor's¹² opinion that if the testis has not descended by the time the child is aged one year, the chances that it will descend later are very remote. Drake¹⁸ however has reported 35 cases of undescended testicle in boys between the ages of nine and nineteen years; in 23 of the 35 boys spontaneous descent occurred between the ages of ten and sixteen years.

2. Cabot and Nesbit¹⁹ believe that orchidopexy "had probably best be performed before the age of nine years.

3. Within the past few years a series of observations has been reported regarding the effect of injections of anterior pituitary-like principle made from the urine of pregnancy upon the male genital

degree, and the process, if inflammatory, may set up a peritonitis through the open processus vaginalis. Hydrocele may exist. Eccles relates a case in which the fluid collected in the scrotal part of the tunica vaginalis, while the testis remained in the inguinal canal.

There seems to be no doubt that the undescended testicle is peculiarly liable to become malignant. This tendency has been attributed to the susceptibility of inguinal testes to repeated trauma, but apparently intra-abdominal testes are also liable to develop tumors. Chevassu, for example, reports 5 tumors in intra-abdominal testes to 10 in inguinal testes. Hinman²⁹ has gathered the statistics of a number of surgeons in regard to the incidence of tumor in undescended testicle. He finds that in a series of 3529 undescended testes, many of which were in children and were therefore not likely as yet to have developed malignancy, one in 588 was malignant, whereas the incidence of testicular tumors in male admissions to the hospital is only one in 1500. He finds furthermore that of 649 testicular tumors, 78, or 1 in 8, were in undescended testes. These facts provide sufficient reason in themselves for the early placement of undescended testes in the scrotum, if this cannot be done, the testicle should be removed, provided the other testicle is normal in size and position.

Torsion is especially prevalent in undescended testes. In the 32 cases of torsion collected by Scudder³⁰ in 1901, 47 per cent were in undescended testes. Eccles (p. 64) gives the following predisposing causes for torsion of the retained testicle:

- 1 Imperfect descent of the testis
- 2 Abnormally long mesorchium
- 3 Practical absence of a mesorchium
- 4 Action of the gubernaculum testis
- 5 A congenital twist of the cord
- 6 A roomy tunica vaginalis
- 7 A flattened condition of an imperfectly descended testis

He believes that the chief predisposing cause at work is partial descent with a freely movable testis.

The exciting causes of torsion he considers to be

- 1 Muscular effort
- 2 A mechanical twist
- 3 The action of the cremaster
- 4 The application of a truss
- 5 Attempts at a reduction of the hernia by taxis
- 6 Approach of puberty

The symptomatology, pathology and treatment of torsion will be taken up under Torsion of the Testicle.

Coincident with failure in the descent of the testicle, there frequently exists failure of the processus vaginalis to close. A path is thereby left open for the protrusion of the abdominal viscera. Every undescended testis, says Moschkowitz, is accompanied by a potential or an actual hernia. In the 92 undescended testes reported by Odiorne and Simmons, hernia was present in 49 (57 per cent). Of these, 10

the parts and the difficulty in keeping the child dry. As to the time of election for operation there is a diversity of opinion. Moschkowitz does not operate on children under three years. Bevan thinks from six to twelve years is the best time. Feeles from six to eight years.

Operative Treatment.—In the history of operative treatment of undescended testicle three operations appear—orchidectomy, reposition of the organ within the abdomen and orchidopexy or the placing of the testicle within the scrotum. Orchidectomy is indicated if the testicle contains a tumor or if some pathological condition exists which renders the gland worthless or dangerous to the individual. Intra-abdominal testes which cannot be brought down into the scrotum should be removed unless both are thus unfortunately situated*. In that event it would seem better to run the risk of future malignancy than to castrate the patient. It is obvious that the inguinal testicle should never be placed in the abdomen. The only justifiable operation for the otherwise healthy retained testicle is orchidopexy and every undescended testicle which can be palpated should according to Bevan be so treated. The first operation for this purpose was described by Schuller** in 1881. He advised closing off the processus vaginalis to make a tunica vaginalis, repair of the accompanying hernia and suture of the testis to the bottom of the scrotum. Various modifications of this operation were suggested the innovation usually consisting of a new method of anchoring the testicle in the scrotum. None of these was generally successful however. The testicle would retract. Even the operation described in 1890 by A. D. Bevan* which for many years was accepted as the standard method for performing orchidopexy failed to give uniformly satisfactory results. Many of his suggestions were valuable however and must be followed in order to bring the testicle well down in the scrotum.

Bevan† pointed out that the structure which prevented the placing of the testicle in the scrotum was not the vas deferens, but was the spermatic cord. He therefore lengthened this cord as much as possible by separating the adhesions between the loops and freeing it from the peritoneum of the lateral and posterior walls of the abdominal cavity. If it was still too short he cut it leaving the testicle to draw its blood supply from the deferential artery. Although anatomical researches by Picqué and Worms‡ have demonstrated a constant anastomosis between the spermatic the deferential and the funicular arteries, the complete division of the spermatic cord has frequently resulted in atrophy of the testicle. Bevan himself writing upon this subject in 1918 still advised the employment of this technique in case the testis could not be brought into the scrotum without tension upon the cord. He said that in between 400 and 500 cases, division of the cord was necessary in only 10 per cent. He admitted that necrosis or atrophy resulted in about 16 of his cases. The fact that since Bevan's first

This situation will arise rarely if at all. By the skillful use of a three-stage operation almost any testis can be brought into a normal position. (Edmond.)

tract Engle²¹ and Moore¹¹ have shown that in the male rat injections of this substance have been followed by an increase in the weight of the genital tract. In 1930 Shapiro⁶¹ reported 13 cases of cryptorchidism in man in which the injection of anterior pituitary-like principle caused greater mobility of the testis in all cases. In 1932 Engle²¹ reported that the testes of the immature rhesus monkey can be made to descend into the scrotum by this means. In 1933 Goldman and Stern²² reported that 2 boys with undescended testes were treated successfully by injections of this principle. Recently Aberle and Jenkins¹ present the results of a series of observations on the use of such a preparation,* both experimentally on monkeys and clinically on 4 boys. They injected into the muscles of the buttocks 100 rat units of this substance three times a week, the total dosage varying from 1900 to 4525 rat units. Their conclusions had best be given in their own words:

"Anterior pituitary-like principle from the urine of pregnancy caused the testes to descend in 2 out of 4 boys receiving injections. In only one instance was the descent complete. The substance caused hypertrophy of the scrotum and testes and in one instance a growth of the penis.

"In immature monkeys (*Macaca Mulatta*) with unilateral orchiectomy, this hormone caused complete descent of the testis in 1 animal and partial descent of the testes in 4. In these 4 animals the fascia surrounding the vas deferens and spermatic vessels was too short to allow the testes to reach the lower part of the scrotum.

"The failure of the treatment may have been due to an incorrect amount of hormone, to age, to nutrition, or to some factor related to the activity of the other endocrine glands. In man a possible external mechanical obstruction and developmental irregularities must be considered.

"Microscopic examination of the testes of the injected monkeys showed marked tubular enlargement, a corresponding increase in interstitial material, but no mature sperm.

"Identical amounts of the anterior pituitary-like factor caused various degrees of hypertrophy in the prostate, seminal vesicles and testes of immature monkeys. The total dosage of the principle administered is not in direct proportion to the distance that the testes descend either in man or in monkey."

Although we must await further reports before accepting this form of treatment as of real value, it would seem justifiable to employ it as a preliminary to operation. Apparently it is without harmful effects (although in one of Aberle and Jenkin's cases the treatment was discontinued because of severe reaction), it brings about greater mobility of the testes (Shapiro) and sometimes induces a complete descent.

Age at Operation—Most writers on this subject are agreed that operation before the age of three is contra-indicated by smallness of

* Follutein. E. R. Squibb & Co. Another similar preparation is antophysin (Winthrop Chemical Company).

lifts up the epigastric artery and vein brings the testis down behind them and by stripping the spermatic cord off the bulge of the peritoneum, he materially shortens its course. Cabot and Nesbit¹⁸ have employed a two-stage operation in cases in which the cord could not be lengthened enough to enable them to place the testis in proper

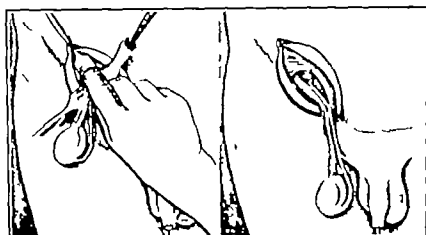


FIG. 222.—Technique of Torek operation. Removal of fibrous tissue from about vessels and freeing of vessels above the internal ring.

position. At the first operation the testis was brought from its position at the internal inguinal ring to just outside the external ring eight months later they again operated upon the patient and found it possible to bring the testicle down to a mid-scrotal position. Traction by an elastic band as employed by Cabot and Nesbit in another series of

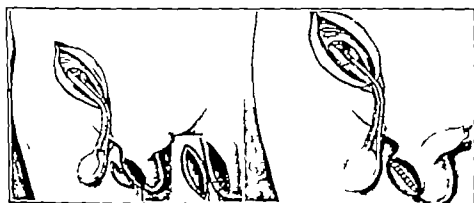


FIG. 223.—Technique of Torek operation. Placing of testis on the thigh to prove sufficient length of vessels. Suture of posterior layer of scrotal incision to incision in thigh.

cases, has also succeeded in drawing down a testis which at the time of operation could be placed no lower than just outside the external inguinal ring. If the shortness of the vas deferens proves to be the factor that prevents proper placement of the testis its course may be shortened by employing Wolfer's procedure previously described.

According to Torek's¹⁹ technique the operator having obtained

article, a number of modifications in technique have been devised, all of which aim to make unnecessary the division of the cord, is proof that this step in the operation is unsatisfactory (Davison,¹⁸ Keyes,³⁴ Mixer,¹¹ Wolfer⁷⁸)

The work of Moore¹¹ and others has shown clearly that the health of the testicle depends upon its position in the very bottom of the scrotum. Bevan's operation could not be depended upon to secure this position, it became evident that some method of exerting traction upon the testicle must be found. Torek⁶⁷ in 1909 described an operation whereby the testis, after being placed in the scrotum, was sutured to the fascia lata of the thigh, at a secondary operation, done no sooner than two months later, the testis was freed from this attachment and the scrotal incision closed. This operation has been done

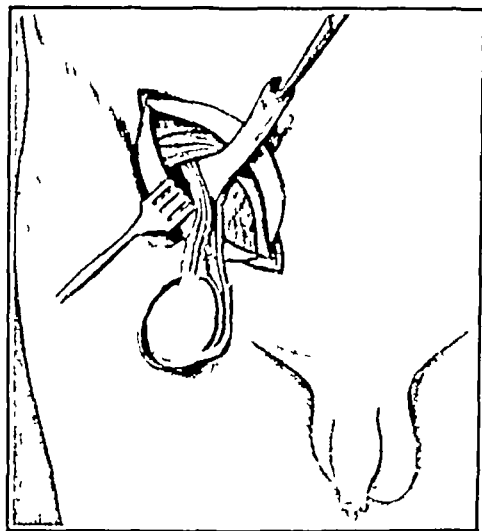


FIG. 231 —Technique of Torek operation. Skin incision. Mobilization of hernial sac and exposure of vessels.

with success by a number of operators, Counseller¹³ used this technique in 20 cases, of which 6 were bilateral, and obtained good results in 93.3 per cent. Walters⁷⁴ has performed this operation with "very satisfactory results" in more than 50 cases. There have been several modifications of this technique.

The incision for this operation is the same as that for repair of inguinal hernia (Fig. 231). Skin and external oblique fascia are incised, the testis is freed by division of the gubernaculum, and the processus vaginalis which surrounds the testis is removed entirely. The upper segment of the processus is freed from the spermatic cord and treated in the same manner as the sac in hernia (Fig. 232). The spermatic vessels are then freed from the peritoneum and the delicate adhesions which bind together the loops of the vessels are divided. By this means the cord is lengthened. If it is still too short to allow for proper descent of the testis, the procedure suggested by Wolfer⁷⁸ may be followed. Wolfer divides the transversalis fascia as far as the pubes,

forceps the testis is grasped and drawn through the scrotum. It is then sutured to the fascia lata by interrupted (00) chromic catgut sutures which just pierce the tunica albuginea (Torek, Fig. 236) or are fastened

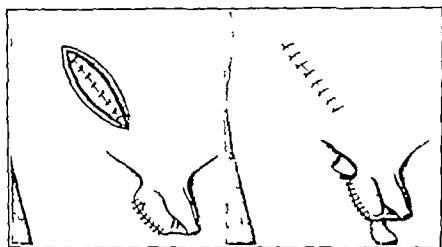


FIG. 236.—Technique of Torek operation. Closure of outer layer of scrotal flap and thigh flap.

to the stump of the gubernaculum or whatever fibrous tissue can be found at the lower pole of the testis (Heller). Wangensteen⁷⁴ has modified this procedure by carrying the sutures that hold the testis to

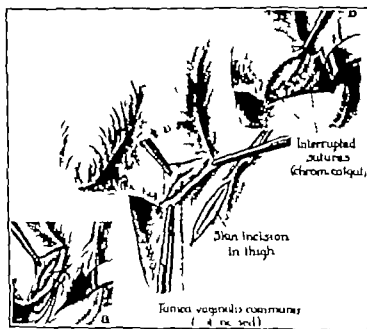


FIG. 237.—Wangensteen's operation. Preparation of tissues of scrotum and thigh for suture and suture of posterior layer.

the thigh through the tunica vaginalis and dartos, thereby preserving the normal thickness of the scrotal wall (Fig. 237). There is some objection to placing these sutures in the tunica albuginea as injury to

sufficient length of cord to allow the testis to be placed in the bottom of the scrotum, passes his finger into the scrotum and by blunt dissection makes a channel to the bottom of the sac. Through a small incision in the bottom of the scrotum a piece of tape is carried through this

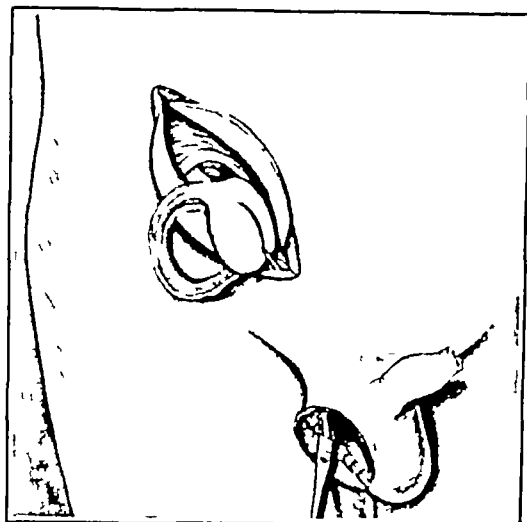


FIG. 234 —Technique of Torek operation. Passage of suture through coverings of testis preliminary to drawing it into the scrotum.

channel and is later used as a guide. The testis is laid upon the inner aspect of the thigh to indicate the location of the thigh incision. An oblique incision, its length somewhat greater than that of the testis and its direction downwards and inwards, is carried through the skin of the thigh down to the fascia lata, the skin is freed by blunt dissec-



FIG. 235 —Technique of Torek operation. Suture of testis to fascia of thigh.

tion beneath both edges. A corresponding incision is made in the scrotum (Figs 233 and 234). The upper edges of both incisions are united by interrupted catgut sutures with knots on the upper or skin surface (Fig. 235). The lower end of the tape is grasped with forceps which are thus led upwards through the scrotal channel. With these

the testis or sepsis may follow. The lower edges of scrotal and thigh incision are then approximated and the inguinal incision is closed as in the operation for hernia (Fig. 238)



FIG. 240 — End-result of a patient of Counseller's in whom a previous bilateral Bevan operation had resulted in return of the testes to the inguinal canals. A two-stage Torek operation was carried out. This photograph was taken after the detachment of the second testis.



FIG. 241 — Position of the testis after the second stage of a three-stage operation for complete abdominal cryptorchidism. The right side has been detached from the thigh. The left is still awaiting detachment (Cabot)

If the inguinal canal is closed according to the technique of Ferguson (the conjoint tendon being fastened to Poupart's ligament in front of the spermatic cord) the path followed by the cord will be shorter

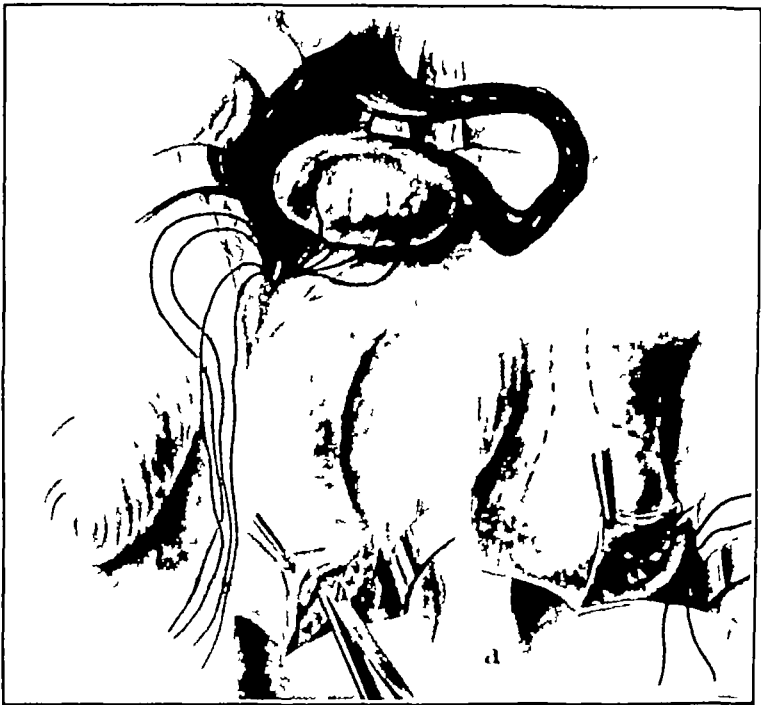


FIG 238 — Passage of sutures through tunica albuginea They are then drawn down through the undivided outer layer of the scrotal fascia and attached to the fascia of the thigh

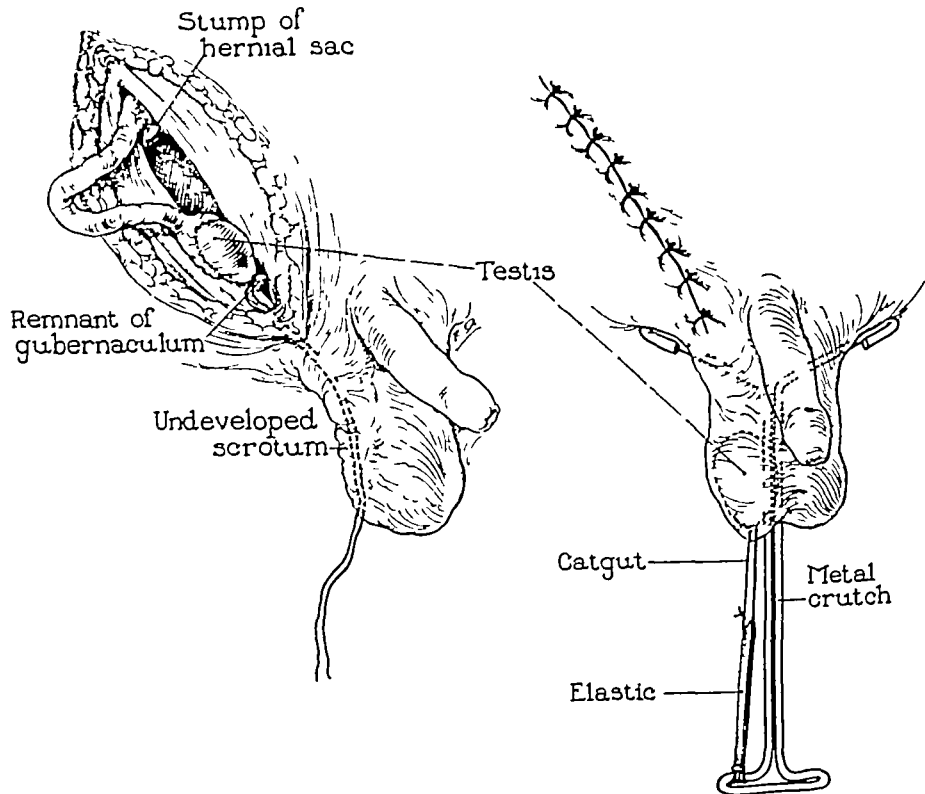


FIG 239

the testis or sepsis may follow. The lower edges of scrotal and thigh incision are then approximated and the inguinal incision is closed as in the operation for hernia (Fig. 238)



FIG. 240.—End result of a patient of Counseller's in whom a previous bilateral Bevan operation had resulted in return of the testes to the inguinal canals. A two-stage Torek operation was carried out. This photograph was taken after the detachment of the second testis.



FIG. 241.—Position of the testis after the second stage of a three-stage operation for complete abdominal cryptorchidism. The right side has been detached from the thigh. The left is still awaiting detachment (Cabot).

If the inguinal canal is closed according to the technique of Ferguson (the conjoint tendon being fastened to Poupart's ligament in front of the spermatic cord) the path followed by the cord will be shorter

than if it is transplanted as in the Bassini operation. The fastening of the testis to the thigh apparently causes very little discomfort, if any, and may be left for a number of months. The two should not be separated in less than two months, this may be done under local anesthesia.

Cabot and Nesbit¹⁰ have exerted traction upon the testis by means of a long catgut suture threaded on a straight needle at each end, this suture is passed through the remains of the gubernaculum or any tab of fibrous tissue at the lower pole of the testis. The suture is tied, both ends are passed through the lowest point of the scrotum and attached to a wire frame by means of a rubber band so as to produce constant gentle downward traction on the testis. This traction is continued for twelve days, being adjusted occasionally so as to remain constant (Fig. 239).

As has been already stated, the results of orchidopexy in which one of the above techniques has been employed are far superior to the results obtained when traction was not used (Figs. 240 and 241.)

Orchidopexy in the case of ectopic testes is usually made easy by the fact that the spermatic cord is already of sufficient length. It is desirable to obliterate the old bed of the testicle, otherwise recurrence may take place.

INJURIES OF THE TESTICLE

Luxation or Dislocation of the Testicle—Luxation or dislocation of the testicle is usually the result of an accident, such as the passage of a wagon wheel across the pelvis. The testicle may be driven over the pubes or toward the anterosuperior spine of the ilium. Guiteras²³ records a case in which the testicle was torn loose from the body and tail of the epididymis and was driven out of the scrotum and under the skin on the side of the penis. A review of the literature by Nicolas,⁴⁹ in 1899, disclosed 3 cases in which the testis had been driven onto the side of the penis, 3 in which it had been driven over the pubis and 2 in which it was forced into the groin. Nicolas says that unless the testis is replaced, it undergoes atrophy. Summerhayes⁶⁴ reported a case in which the testicle was extruded through a rent in the scrotum by a blow from a log of wood.

Hematocoele.—Hematocoele is a frequent accompaniment of injuries of the testicle. The tunica fills with blood, which clots and forms a tender, solid-feeling tumor, which does not transmit light. Later on, this will liquefy and become a dark brown, oily-looking fluid, or will be entirely absorbed. From an injury of less severity, traumatic *hydrocele* may result. Hydroceles of this origin are only temporary. Severe injuries of the testicle itself are not met with very frequently. The fact that the testes lie in a movable bed, between the fleshy parts of the thighs, saves them from many a crushing blow. The most frequent type of injury is that sustained by falling astride some hard object, such as a fence. In such cases the testicles are caught between the hard object and the bony pelvis.

Terrillon and Suchard⁴⁴ in experimental work on dogs showed that punctured wounds and foreign bodies in the testicle caused only local disturbance. Slight blows upon the fixed testicle caused only a feeble reaction. More severe blows caused reaction in both testis and epididymis, more marked in the latter. The epididymal canals were dilated, the cilia of the epithelium was lost and the epithelium was thickened in places by the accumulation of new cells. Injuries of still greater degree caused the formation of fibrin in the tunica and in the testis the degeneration of peripheral tubules and an inflammatory reaction in the interstitial tissue. Terrillon and Suchard thought this inflammation would result later in the formation of scar tissue and the consequent atrophy of the testis. Injuries of the most severe type caused rupture of the tunica albuginea. The testicle contained ecchymotic areas and was of a yellowish-red color, the epididymis was swollen and ecchymotic and examination of microscopic preparations showed proliferation in the interstitial tissues as well as in the canals.

Terrillon and Suchard conclude that changes are more marked in the epididymis than in the testis. In the former the epithelium is chiefly involved, in the latter the interstitial tissue. The subsidence of the interstitial reaction is likely to cause scar formation with resulting atrophy of the testicle.

The treatment consists of rest, elevation of the scrotum and the application of ice.

TORSION OF THE TESTICLE.

Incidence.—Torsion is probably more frequent than would appear from the cases reported. Without doubt a number of cases are thought to be orchitis or epididymitis, and if they quiet down the diagnosis is never made. From 1840 when the first case was reported to 1901 Scudder⁴⁵ collected 31 instances from the literature and added 1. In 1907 Rigby and Howard⁴⁷ collected 40 cases.

Age.—Torsion may occur at any age. It has been reported in a newborn child and in a man aged sixty-two years. It is chiefly a disease of adolescence. Of Scudder's series of 32 cases 75 per cent were under twenty-four years of age, 20 of the 32 were between the ages of thirteen and twenty-three years.

Cause.—That torsion is due primarily to some anatomical abnormality is indicated by the fact that of Scudder's 32 cases of torsion 47 per cent were of undescended testicles. A number of those who have reported cases have mentioned finding some anomaly such as an unusually long mesorchium.

The predisposing factors which have been found associated with torsion of the undescended testis are given on page 416. In connection with fully descended testicles, Rigby and Howard mention the following anomalies:

1. Abnormal attachment of the common mesentery and vessels to the lower pole of the testis and to the globus minor so that the testis is attached by a narrow stalk instead of by a broad band.

2 Elongation of the globus minor

3 Capacious tunica vaginalis

The exciting cause may be exercise or violent straining, but 2 cases are reported by Rigby and Howard in which torsion occurred during sleep. In a case recently operated at the Massachusetts General



FIG. 242 —Gangrene of the testicle due to torsion of the cord. The testicle and epididymis were gangrenous from a point just above the epididymis. Testicle and epididymis considerably enlarged from edema. There were areas of hemorrhage and beginning necrosis on the surface and in the interior of the organs. There was associated hydrocele of the cord dependent upon the strangulation of the cord. (Scudder.)

Hospital the torsion came on during sleep. A case of recurrent torsion has been recorded⁶⁹ in which the patient learned to untwist the torsion himself.

Pathology —Upon opening the tunica, more or less bloody fluid is evacuated, the testis and epididymis appear swollen, indurated and

almost black in color. The spermatic cord is thrombosed below the twist, normal above. The twist may consist of from one-half a turn to four half turns, in either direction. The cut surface of the testicle resembles blood clot. Hemorrhagic infarction may occur or hemorrhage between the lobules (Scudder). In one of Rigby and Howard's cases microscopic examination showed no normal testicular cells. Later stages of the lesion will show atrophy, more or less complete or sloughing. The latter is more liable to occur if hernia coexists. Rigby and Howard believe as the bacteria of the intestine are thus brought nearer to the devitalized testis.

Symptoms.—Severe sudden pain in the testicle sufficient to cause slight shock with nausea and vomiting occurs at the time of the twist. Not infrequently this occurs at night. The temperature may rise slightly. The skin over the affected testicle becomes edematous and red. Differentiation between the testicle and epididymis on palpation is lost. At first the tumor is exquisitely sensitive; after a few days the acute tenderness subsides, but tenderness on pressure may persist for weeks.

Diagnosis.—In the case of torsion of the undescended testis the condition most difficult to differentiate is strangulated hernia. (See page 417.) With the testicle fully descended hernia is more easily excluded. To diagnose the case as acute epididymitis is the most usual mistake. In the early hours of epididymitis before the epididymis shows much swelling the physical signs are indeed similar. The sudden onset of an epididymitis in a boy or youth who shows no evidence of urethral infection is strongly suggestive of torsion. Epididymitis is seldom so excruciatingly tender during its inception.

Treatment.—If the case is seen within the first hour or two an attempt may be made to untwist the cord. The testis is supported by one hand and gently rotated with the other. As one cannot be sure of the direction in which the testicle has turned, this measure does not offer much hope. It was done successfully by Nash⁶⁵ one hour after the onset, but atrophy subsequently occurred. When torsion occurs in an undescended testicle the gland should be removed promptly to avoid the possibility of peritonitis. With fully descended testes expectant treatment may be employed. The patient should be kept in bed, the scrotum elevated and ice applied. Rigby and Howard followed this treatment in 4 cases. Two of the testes atrophied very little, one disappeared altogether, none sloughed. The operative reduction of the torsion with suturing of the testicle to prevent recurrence has always resulted in atrophy and seems to offer no better chances for preserving the testicle. It seems justifiable to try the expectant method for a few days as even an atrophied testicle means more to the patient than none at all. If however the symptoms do not speedily subside or if tenderness of the testicle persists, orchidectomy should be done.

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CHAPTER XI.

DISEASES OF THE SCROTUM.

By ALEXANDER R STEVENS, M D , F A C S

THE most common pathological lesions of the scrotum are those inflammatory conditions secondary to diseases of the testicles, the urethra, and the rectum. These scrotal complications will be dealt with in their appropriate connections in the sections devoted to the above-named primary seats of infections.

ANATOMY OF THE SCROTUM.

The scrotum is a loose pouch of skin investing the testicles and part of the spermatic cords. It varies markedly in size in different individuals, and with changing conditions in the same individual. In debilitated persons and the aged, and from the effect of heat, it relaxes and becomes pendulous, in the robust and the young, and under the influence of cold, emotion, and exercise it is contracted and thicker. The layers are skin, dartos, and loose areolar tissue.

The Skin.—The skin of the scrotum is thin, semitransparent, and elastic, is darker in color here than elsewhere, and has a sparse growth of hair. It contains in the derma many sebaceous and sweat glands. Superficially its epidermis is similar microscopically to that over the rest of the body. Below this is the derma, rich in elastic fibers and involuntary muscle. The surface of the skin is divided into lateral halves by a slight median ridge, the raphé, extending from the penis to the margin of the anus. Below the raphé is the septum completely separating the two scrotal cavities which contain the testicles, and from the raphé, on either side, extend rugæ with a generally horizontal arrangement, determined by muscular fibers in the dartos, parallel to the surface and running, as a rule, longitudinally.

Dartos —The dartos is immediately beneath the skin and intimately associated therewith. But contrary to the statement of some anatomists, it can be dissected from the skin. The line of cleavage is proved microscopically to be between the muscle layer of the derma and that of the dartos. The dartos is a reddish-brown stratum, best developed in front and at the sides, continuous with the suspensory ligament of the penis and the superficial fascia of the abdomen, groin and perineum, and at the sides is attached to the ischiopubic ramæ. It is the contractile portion of the scrotum, containing connective tissue, elastic fibers, and considerable unstriped muscle, the fibers of which are placed at right angles to those of the derma. It is very vascular and entirely

free from fat. The dartos forms two sacs, for the corresponding testes and these unite in the median line to form the septum scroti.

Areolar Tissue—Beneath the dartos is a very loose thin bed of vascular areolar tissue, continuous with Colles' fascia behind and with the deep fascia of the abdomen in front. Scrotal hematomata are commonly situated here.

Blood vessels.—The arteries supplying the scrotum are the external pudics (from the femoral arteries) and the superficial perineal branch of the internal pudic. The veins accompanying the arteries empty into the saphenous and internal pudic veins.

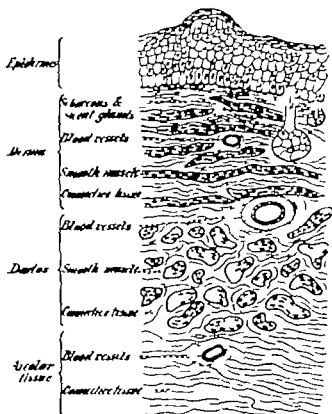


FIG. 243.—Diagrammatic section of scrotal wall.

The lymphatics of the scrotum all terminate in the inguinal and femoral glands. The observations of Morley would seem to show a free anastomosis of the lymphatics of the two halves of the scrotum, a free communication of these with the lymphatics of the penis and to a less extent with those of the thighs and perineum. The fine network between the skin and dartos empties into lymph trunks which dip at once through the dartos. There are ten to twenty main trunks on either side, which course toward the inguinal glands. It is surgically interesting that the uppermost ones may curve up 1 to 2.5 cm. on the side of the penis, thence run 1 cm. above the pubic spine parallel to Poupart's ligament, ending in a gland sometimes only 4 cm. from the anterior superior spine. No collecting trunks are found to accompany

the internal pudic vessels, and there apparently is no connection between the lymphatics of the scrotum and those of the tunica vaginalis and testicles

Nerves —The nerves supplying sensation to the scrotum are branches of the ilio-inguinal, superficial perineal branches of the pudic nerve, the inferior pudendal (from the small sciatic), and the genital branch of the genitocrural. The sympathetic nerves accompanying the vessels supply the muscle fibers of the dartos.

PHYSIOLOGY OF THE SCROTUM

The physiology of the scrotum was but vaguely understood prior to the classic work of Moore²⁸ and his associates. By the experimental method, dealing chiefly with rats, guinea-pigs and rams, they have demonstrated the function of the scrotum as a temperature regulator of the testes. It has been proven that testicles placed within the abdominal cavity lose the spermatogenic function, and those fixed in a subcutaneous position may continue this function for three to nine months but produce no spermatozoa. A ram's testicle remaining in the scrotum but continuously wrapped with cotton loses its ability to produce spermatozoa.

Thus prolonged body temperature destroys the spermatogenic function of the testicle without interfering with the testicular internal secretion affording development and continuance of sexual ability and of secondary male characteristics.

Nature has placed the male gonads of certain animals including man outside the body in a contractile bag (the scrotum). Relaxation permits a lower temperature of its contents, while contraction (with corresponding thickening of this vascular sac) reduces the chance of loss of heat by radiation. This work also explains the sterility invariably found in patients with undescended abdominal testes.

ABNORMALITIES OF THE SCROTUM

The half of the scrotum corresponding to an undescended testicle is frequently rudimentary. In pseudo-hermaphroditism the scrotum is cleft, the halves resembling labia majora. Partial cleft scrotum may accompany congenital defects elsewhere in the genito-urinary system, *e. g.*, abnormalities of the penis and urethra, and ectopia vesicæ.

Abnormal pigmentation of the scrotum may be mentioned here to note that the pigment granules are placed histologically in the same location as those normally found—that is, in the deepest cells of the epidermis.

INJURIES OF THE SCROTUM

Stab, puncture, and gunshot wounds are subject to the same surgical consideration as similar injuries elsewhere. Growing hematomata should be freely incised, clots removed, and bleeding-points ligated. Free drainage must be established in the presence of infection or an injury to the urethra.

Hematoma.—Hematoma without rupture of the cutaneous surface is common and is easily produced by blows upon the scrotum. It is important to differentiate hematocele and hemorrhage within the testicle from hematoma in the substance of the scrotal wall; the former frequently requires operation while the latter rarely does but is best treated by rest, elevation and cold applications with perhaps a compression bandage.

Loss of Substance.—Loss of substance from accident or attempts at emasculation may lead to serious bleeding. Control of hemorrhage is of first importance, then surgical cleanliness and subsequent aseptic dressing. The reparative power of the scrotum is amazing. After the loss of over two-thirds of this tissue leaving the testicles exposed and dangling it is quite possible for nature to repair this vast rent and restore a satisfactory scrotum without surgical interference. For this reason one method of treatment, after all hemorrhage is controlled is merely to keep the raw area covered with a mildly antiseptic dressing. However the course of such repair is slow and may be further prolonged by active fungous outgrowth of granulations from the testicles necessitating application of the actual cautery. Better results in extensive injuries and a shorter convalescence are obtained by operation. By loosening the skin of the inner and anterior aspects of the thigh flaps may be cut with horizontal sides, and with the externally placed attachments broader than the free end. These when sewed together will easily cover the testicles and form an adequate sac. In some cases after loosening the skin from underlying tissues over a wider area including the perineum the edges may be apposed without actual flap formation and with ultimately good results. If only the anterior wall of the scrotum is wanting the simplest procedure is to draw upward the remaining portion of the sac and suture it to the upper skin margin. Should the skin of the base of the penis also be lost the penis may be pushed under that part of the scrotum drawn forward and brought out at a lower level. Subsequently flaps of skin from the lateral aspects of the scrotum are used to cover any raw surface on the penis. If for any reason early operation similar to the foregoing procedures is not employed and the exposed area has become covered with fresh granulations more rapid healing may be obtained by the application of Thiersch grafts to the raw surface.

Suture of the Scrotum.—As already stated the dartos is closely attached to the skin and its muscular fibers are generally at right angles to those in the skin. This explains the tendency of the skin edges to curl in regardless of the direction of the incision. Approximation of the skin does not necessarily include the dartos and areolar layer and subsequently bleeding from this very vascular region may occur forming a large hematoma. This may be guarded against by employing hemostatic sutures. Each is applied about 1 cm. from the margins of the wound penetrating both layers of the skin and dartos and returning in the reverse direction 1 cm. apart the knot is tied on the side first entered. Subsequently a line of continuous sutures accurately approximates the skin edges. However both objects may

be attained in a very practical way by one line of sutures, interrupted or continuous, applied about 0.5 cm from the margins of the wound and taking each time a good bite of the deeper structures. By another method, using interrupted sutures, each stitch is carried one way through both skin and deeper structures, and returning takes only a small bite of skin. Obviously, the knot is tied on the side first penetrated by the needle.

CUTANEOUS DISEASES OF THE SCROTUM.

Cutaneous diseases will be dealt with very briefly. Fuller discussions are readily found in works on dermatology.

Erythema Intertrigo (Chafing).—Erythema intertrigo affects the lateral and posterior aspects of the scrotum. It may occur at any age, but more commonly in children and fat individuals. Uncleanliness, wetness (urine or perspiration), and friction in walking are the three chief etiological factors. The treatment is simple; cleanliness, dryness, the use of a dusting powder, and a suspensory with perhaps some padding of cotton. Dermatitis or eczema may develop, requiring appropriate lotions or ointments.

Eczema Simplex.—Eczema simplex is said to be more frequently met with in persons of rheumatic or gouty diathesis. Its common seat is the lateral and posterior aspects of the scrotum. The lesions and symptoms are those of eczema in other parts of the body. Treatment in milder cases consists simply of support of the scrotum, avoidance of friction, and application of a dusting powder, such as the oxide or stearate of zinc. Itching is relieved by 2 to 4 per cent carbolic acid applied alone on gauze or incorporated in some simple lotion or ointment.

Chronic cases, with thickened cracking skin, are much relieved by occasional applications of a mixture of chrysarobin 4, chloroform 16, benz comp 60. Some of these are helped or even cured by exposure to roentgen-ray.

Eczema Marginatum.—Erythema marginatum is ringworm modified by erythema or eczema intertrigo, and, indeed, the parasitic nature of the affection may be obscured by these accompaniments. It occurs on the moist regions of the scrotum in patches, which present well defined margins and elevated borders and characteristic central healing and peripheral advance. Treatment should be directed first to any associated erythema or eczema. Subsequently the affected spots are painted on several occasions with tincture of iodine, or unguentum hydrargyri ammoniati is well rubbed in daily and the applications continued some days after an apparent cure.

Pityriasis Versicolor.—Pityriasis versicolor occurs as yellowish-brown spots or patches on the scrotum, and is caused here as elsewhere by a vegetable parasite, *microsporon furfur*, which attacks clean as well as dirty skins. There may be mild itching but often no symptoms exist. This vegetable growth may be made to disappear by daily

scrubbing with soap and water followed by application of 25 per cent aqueous solution of sodium hyposulphite. Recurrence is frequent.

Pediculi Pubis — *Pediculi pubis* are sometimes found about the hair of the scrotum, usually in association with a similar occupation of the hair of the pubic region. The ova (nits) are tightly attached to the hairs and their presence is as pathognomonic as the parasite. An eczema may co-exist in the uncared for cases. The parasites and their ova are easily killed by unguentum hydrarg. by 1 to 1000 solution of bichloride of mercury by kerosene or the tincture of larkspur. In patients harboring a large colony and especially in uncleanly individuals it is advisable first to shave all hair from the parts.

Scabies — Scabies is carried to the genitalia by the hands. The characteristic burrows of the parasite of scabies *Acarus scabies* may be seen. Numerous punctate abrasions and excoriated papules and a few crusts are often found. Itching most marked at night is almost invariably present. Treatment is simple and effective: a warm bath, sulphur ointment rubbed over all affected regions morning and night for several days followed by another bath and a change to fresh clothes. A second course of treatment may be required if a bland lotion or ointment does not clear up the skin in a few days.

Syphilis — Syphilis of the scrotum is common, most frequently seen as papules which on the moist surfaces become macerated and abraded. If untreated they may develop papillary outgrowths forming warty or cauliflower-like excrescences (condylomata). Ulcero-serpiginous lesions may develop here and less frequently gummata or single ragged ulcers. The occasional development of chancre of the scrotum must be emphasized. Only cleanliness is necessary locally if the intensive constitutional treatment of syphilis be instituted.

Lupus. — Lupus of the scrotum is comparatively rare.

Pruritus. — Pruritus occurs with some of the above diseases and also without demonstrable skin lesions. The latter cases have frequently some constitutional debility as gout, rheumatism or diabetes. Treatment is often most unsatisfactory except as affording temporary relief. One must first institute dietetic and hygienic measures aimed at fundamental constitutional disorders. Tonics or alkalis may be indicated. Turkish baths are sometimes beneficial. Locally thymol, weak carbolic acid or menthol in lotions or ointments and sometimes hot water relieve the symptoms temporarily.

Sebaceous Cysts or Steatoma. — These are formed as elsewhere on the skin from sebaceous glands dilated by retained secretion. Small palpable cysts of the scrotum are present in many individuals, and not infrequently isolated ones attain a diameter of 5 to 10 mm. Single cysts may occur anywhere on the scrotum, large groups are more commonly found on the anterior aspect. They are yellowish, rounded and firm within (not under) the skin, the larger ones protruding externally. They cause no symptoms unless infected, then they are tender and the surrounding skin is reddened. No treatment is indicated except for cosmetic results or for inflammation. They may be excised under

local anesthesia, or incised, the contents evacuated, and the sac destroyed by cauetting, or by cauterization—easily done with pure carbolic acid

Varicose Veins.—The veins of the scrotum may show marked varicosity, which has been confused with varicose veins of the pampiniform plexus. This should not occur if careful palpation is made. However, the two conditions frequently occur together. Small telangiectatic spots may accompany the varicosity. Usually no treatment is needed. Bruyneel² reported an instance of spontaneous rupture of varicose veins of the scrotum, with loss of about 200 cc. of blood, in a man, aged seventy-seven years. It is conceivable that the size of the mass may be a source of annoyance. The veins are largest in lax, elongated scroti, and the easiest treatment is excision of the skin area most involved and its contained veins, careful hemostasis by ligature and proper placing of deep skin sutures.

RELAXATION OF THE SCROTUM

Moderate relaxation of the scrotum is commonly found associated with large varicoceles, and sometimes, indeed, with small varicoceles. As a rule, this needs no special attention, as excision of the varicocele with suture of the distal stump to the aponeurosis over the external inguinal ring will materially reduce the scrotal contents, hold the testis high, and permit recovery of muscular tone and recontracture of the scrotal wall. Some surgeons prefer to excise part of the scrotum in many cases, but this is really necessary in but few extreme cases where the dartos has apparently atrophied following prolonged and excessive overstretching. In such instances, no harm is done and much comfort may be afforded the patient, by a generous excision of the lower part of the scrotum, great care must be employed to avoid infection, and to so place sutures that hematomata will not form.

INFLAMMATION OF THE SCROTUM.

Edema.—Angineurotic edema may attack the scrotum and penis alone, or in association with involvement of other parts of the body, such as the face or hands. These cases are relatively rare and should be recognized by the rapidity of formation, its possible evanescent character, the lack of tenderness, fever and other signs of inflammation, and the failure of careful examination to demonstrate one of the commoner causes of edema.

Edema may be secondary to severe anemia and to organic disease of the heart, kidneys, or liver, and is then often part of a general anasarca. It may be due to mechanical pressure on veins or lymphatics draining the scrotal tissues, or edema may be inflammatory in origin, from infection of the testicles, perineum, groins, or scrotal wall. In every case the treatment should be directed to the primary trouble. In the edemas of systemic causation and those due to mechanical pressure, rarely are any local measures indicated other than support

by strapping or a suspensory cleanliness, and dryness of the skin. It is unusual that tension develops sufficiently to endanger the vitality of the skin. When it does so a few punctures may be made in the skin and the parts kept covered with a sterile wet dressing and every care taken to prevent infection.

Cellulitis and Abscess — Cellulitis and abscess are in the vast majority of cases secondary to inflammation of deeper structures but may be due to infection of the scrotum *per se*. Cold wet applications and support of the parts will suffice for milder infections. Severe cellulitis and abscess require incision and drainage.

Erysipelas. — Erysipelas is most frequent in old or debilitated individuals. The onset is announced with a chill, high fever and malaise. Locally a bright red spot develops and gradually spreads over part or all of the scrotum. The latter swells markedly, is sometimes covered with blebs and may finally become gangrenous. On the other hand (and usually) there may be complete resolution and a return to normal. The constitutional symptoms are those of erysipelas elsewhere. Also the bacteria found here are the same as those causing the disease in other locations. It is worthy of note that in some cases resembling erysipelas of the scrotum clinically the Klebs-Loeffler bacillus has been cultivated from the wound discharge. The treatment general and local is similar to that of erysipelas in other regions remembering always to keep the scrotum elevated. A great variety of local applications have enjoyed temporary popularity. Cold compresses wet with boric acid solution are as satisfactory as any local treatment.

Gangrene — Gangrene of the scrotum may be due to infection of deeper structures (urethra or testicles) through vascular obstruction and bacterial invasion of the scrotal wall to primary scrotal infection (*e g* erysipelas) to mechanical or chemical or thermal injury to trophic disturbances and to systemic conditions acting as primary or predisposing causes (diabetes cardiovascular and renal diseases, alcoholism general debility). Gangrene may be made of rarer occurrence by aseptic care of wounds free incision (not too long delayed) timely surgical treatment of the deeper inflammations and painstaking care of the medical conditions mentioned above. Treatment is logically at once directed to the underlying causative factors. Locally incision through the dartos is to be made and all definitely gangrenous tissue excised. Aseptic dressings are changed frequently until all evidence of active inflammation has disappeared. The testicles are rarely involved secondarily but if the loss of substance has been great are left freely exposed. Left to Nature those large gaping wounds will heal fairly rapidly and with finally satisfactory results. But in many instances a quicker convalescence may be had by some plastic operation (noted under Injuries).

Attention should be drawn to a group of cases commonly described as *Idiopathic* or *Spontaneous* or (better) *Fulminating Gangrene*. The onset is abrupt and accompanied frequently by chills high fever nausea and vomiting. Rapid swelling of the scrotum ensues it be-

comes edematous, hot and tender. The skin becomes tense and shiny, the color is at first bright red, but this soon deepens to a brown with approaching gangrene, which develops quickly—sometimes within thirty-six hours. There may be simultaneous or extending involvement of the penis and later involvement of the lower abdominal wall, less commonly of the perineum and buttocks. Crepitation may be, but is not always, felt. Toxemia may be profound, causing prostration, delirium and death. No definite portal of entry for bacteria is to be found in the skin, and the disease may appear in an otherwise healthy-looking man. However, these patients are always dirty, and infection probably enters through minute breaks in the scrotal skin.

The best results are obtained from early operation, wide excision of all the involved tissue. The infectious process does not include the testicles, and they are not disturbed. The wound is left gaping and packed gently with wet, non-irritating, antiseptic dressings (such as potassium permanganate). Some writers advise the use of anti-streptococcus or polyvalent anti-anaerobic serum.

From a rather wide experience at Bellevue Hospital, New York City, we know the prognosis of such cases to be usually favorable if they are recognized early and subjected to radical operation before the process has extended beyond the scrotum and penis and before the toxemia has become extreme, otherwise the mortality is high. In large groups of reported cases the mortality ranges from 20 to 25 per cent. Extensive thrombosis occurs early, explaining the rapid appearance of gangrene, sometimes pockets of free pus are found at operation.

Published reports and our own work indicate a variability and multiplicity of organisms found. The outstanding ones are *Streptococcus hæmolyticus* and a group of anaerobic organisms, both aerobic and anaerobic bacteria may be found in the same case. No single organism has yet been established as the universal offender, and the condition stands as a clinical entity only.

Emphysema—Emphysema is seen in connection with general subcutaneous emphysema, and sometimes with scrotal gangrene or wounds in which gas-producing organisms are present. Treatment is multiple incision and free drainage in the infected cases. When an anaerobic organism is the offender, frequent irrigation with hydrogen peroxide should be employed.

Granuloma Inguinale.—Formerly supposed to be a disease confined to the tropics, granuloma inguinale has been recognized by various workers in patients who had never been out of the United States. Ulcerating or sclerosing or serpiginous granuloma of the external genitalia, as described in the older literature, is apparently the same disease. It involves not only the scrotum, penis and labia, but the skin of the neighboring groins and thighs, and is occasionally found on the face and neck. It is found on both sexes, more commonly in the male, and far more frequently in colored than in white races.

The period of incubation is unknown. The initial lesion is a papule easily overlooked. Ulceration develops with eccentric involvement of the surrounding tissue first as a reddish elevated ridge which in turn ulcerates as the next adjoining tissue becomes raised. There is but slight enlargement of the inguinal lymph nodes although the overlying skin may become characteristically involved. Usually the lesions are but slightly tender but they may be both very painful and markedly sensitive. If not treated they may exist for years. The advanced ulcerations have a foul odor which to trained nostrils is characteristic of the disease. At times there is seen a tendency of old lesions to partially heal by the formation of dense scar. Marked edema and elephantiasis may develop particularly if there be associated syphilis.

The etiology is uncertain but in smears from the tissue there are found groups of encapsulated Gram negative coccoid or coccobacillary forms, within large mononuclear cells. These were first described by Donovan and are known as Donovan bodies. Their classification is not established and indeed their relationship to the disease is not certain. By culture cocci or oblong forms are obtained some observers reporting capsules and others none. Attempts to produce typical lesions by injecting these organisms in laboratory animals and in man have failed (Campbell).

Histologically there is found infiltration with round cells and endothelial leukocytes with plasma cells and eosinophiles showing in places marked perivascular involvement. Fibrosis is marked. Giant cells and caseation are notoriously absent. The picture is similar to that of a simple granuloma.

Treatment.—With persistent treatment the disease can nearly always be made to disappear usually within six weeks. Recurrences are common unless the treatment is continued two weeks after apparent cure. Indeed an occasional course of treatment over a six months period has been advised. Potassium antimony tartrate (tartar emetic) is a specific. A 1 per cent solution is prepared for use by passing it through a Berkefeld filter until it is proven sterile by culture after which 0.5 cc. of hydrochloric acid is added to 500 cc. of the solution to prevent precipitation. This is given intravenously slowly three times a week beginning with 2 cc. and increasing 1 cc. a dose until 10 cc. is reached. Enough sterile water is added to each dose to make the total 10 cc. Larger doses have been used but are apt to produce disagreeable reactions and continuing the treatment with 10 cc. of the 1 per cent solution suffices. Randall²⁴ has tried other related drugs and his results with sodium antimony thio glycollate indicate this drug to be effective and less toxic than tartar emetic.

Calculi.—Calculi of the scrotum have been described. They are calcified hematmata true urinary calculi which have ulcerated through from the urethra, or the remnants of calcareous deposits in old urinary fistule.

ELEPHANTIASIS (FILARIAL) OF THE SCROTUM.

The term elephantiasis is used to describe large diffuse enlargements of the scrotum, consisting of hard edema and hyperplasia of both the skin and connective tissue. While it is comparatively common in certain tropical countries, in the localities favorable for breeding of mosquitoes, it is rare in colder climates, and most of the patients seen have resided in the tropics. It is particularly prevalent in Samoa and Huahine.

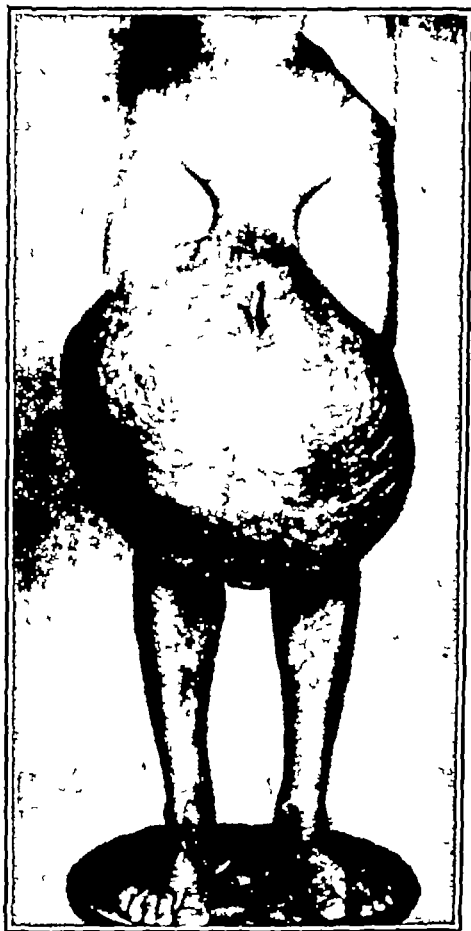


FIG. 244 —Solid form of elephantiasis (Charles)

Etiology —The observations and deductions of competent students of elephantiasis are convincing in ascribing this condition, in at least the majority of cases, primarily to a nematode, known as *Filaria sanguinis hominis* (or *Filaria nocturna*, or *Filaria bancrofti*). This is one of five or six filariæ found in man, and one of the two of these which are pathogenic. The larval forms frequently found in the blood are transparent, colorless, and cylindrical, 0.3 mm long and about the diameter of a red blood corpuscle. In a fresh specimen the larvæ wiggle within encasing sheaths without changing position on the slide.

They are in the peripheral blood only at night mostly at midnight the time of greatest activity of the mosquito. This periodicity may be reversed by having the patient sleep in the daytime. It has been suggested by O'Connor²¹ that filarial periodicity is probably due to the simultaneous cyclical parturition of the gravid female filaria which in turn may be influenced by the habits of the host. During their absence from the peripheral vessels the larvæ are in the larger arteries, the lungs and to a less extent in the heart muscle. Several observers have described a parasite morphologically the same as *Filaria bancrofti* present in peripheral blood in the daytime as well as night time. But this is not the rule.

The complete life-cycle involves two hosts man and certain mosquitoes (Manson mentions eight species which may serve as intermediate hosts). The mosquito feeding on the blood of an infected individual takes in the larval form of filaria these escape from their sheaths in the mosquito's stomach and then acquire locomotion they enter the thoracic muscles and in the next twelve to twenty days increase in size and develop an alimentary canal and other parts the majority reach the proboscis of the mosquito and are usually arranged in pairs. The mosquito now is capable of infecting human beings when feeding on their blood and possibly through drinking water when dying in the same. In man the filariæ soon reach the lymphatics attain sexual maturity and pour larvæ into the lymph thence to the blood. The adult worms are hair like transparent and 4 to 9 cm long the female longer than the male. The sexes live together often inextricably coiled in lymphatics lymph varices or glands.

While it may be supposed that larvæ often reach the blood stream *via* the thoracic duct a very significant observation by O'Connor²¹ suggests otherwise. On detailed examination of autopsy specimens from a case suspected to have filarial involvement of the spermatic cord he demonstrated a female worm attached to the wall of a lymphatic vessel free larvæ in the lumen of a dilated lymphatic and others migrating through the wall to neighboring blood vessels.

Filarial disease does its chief harm through obstruction of lymphatic vessels. This may be caused by the adult worm alive or cretified acting as a plug inducing thrombus formation or inciting inflammatory thickening of the vessel wall and consequent narrowing of its lumen. The microfilaræ (larvæ) have no known pathological effect but ova have been found in the lymph and as they are incapable of traversing lymph glands it seems quite possible that lymph stasis may sometimes be caused by ova being lodged in the glands.

Pathology—The immediate results of obstruction are lymphatic varicosities or edema or both. These conditions are most common for obvious reasons on the lower extremities. The scrotum is involved next in frequency. Lymph varicosities of the scrotal wall cause a moderate or greater enlargement called lymph scrotum. A report by Acton and Rao¹ states that they found only 9 cases of true lymph scrotum among 1024 patients admitted to hospital for filariasis and all

of these 9 cases had had earlier operation for hydrocele. They think lymph-scrotum is due to an outpouring of lymph from about the testicles, faster than the lymphatics of the scrotal wall can carry it away. The skin of lymph scrotum is soft and silky and on inspection presents evident varices. Microfilariae are usually present in the lymph locally. Often the inguinal and femoral glands are enlarged. Erysipelatous inflammation is a frequent complication. Lymph scrotum may remain such or become elephantiasis which, according to hitherto prevalent views, is the combined result of lymph stasis and recurrent inflammation. However, recent experimental work by Drinker and his collaborators indicates that some degree of elephantiasis may ensue without inflammation, although inflammation hastens and exaggerates the process (see later). A lymph scrotum may become large, but not excessively so, as may be the case with elephantiasis. Lymph stasis alone causes varices and edema with perhaps some tissue hypertrophy, but clinically the sequence of events in filarial elephantiasis is lymph stasis (from causes already given), lymphangitis (usually due to streptococcus), imperfect absorption of the inflammatory products, and gradual, intermittent, progressive, inflammatory hypertrophy. The derma becomes dense, fibrous, and enormously hypertrophied. The connective tissue is increased in bulk and has a blubbery appearance, on section there is a free oozing of lymph. Blood-vessels are enlarged and lymphatics dilated.

Symptoms—Beginning as edema or lymph scrotum, the scrotum is only a little enlarged. Attacks of lymphangitis with cellulitis and fever may occur. After this subsides the parts do not return quite to normal. Increased edema and repeated recurrent lymphangitis lead to greater enlargement. The scrotum in typical elephantiasis may weigh 200 pounds (one of 224 pounds is recorded). The mass is pyriform in shape, a transverse section of the upper part is triangular with the apex toward the anus. The skin is leathery, rough and coarse, and pits little, if at all. It is thickest at the bottom, thinnest at the top, and thin and soft at the sides and posteriorly. It gradually merges all around into the healthy skin. Mouths of follicles are sometimes very distinct, the hair is coarse and sparse. The penis is at the upper and anterior part, at the bottom of a channel formed by the foreskin and skin of the penis dragged inside out by the enlargement of the scrotum. The testes are usually in the posterior part of the mass, nearer the bottom than top, each held there by its hypertrophied gubernaculum testis. The spermatic cords are thickened and very long, and hydroceles are usually present. The tumor mass may grow rapidly or slowly, may become enormous in two or three years or may never grow large. An attack of lymphangitis may intervene, causing painful cord-like swellings of lymph trunks and glands, with redness of the overlying skin, chill and high fever, headache, perhaps vomiting, and sometimes delirium.

The general health may be excellent except during the attacks of inflammation. The scrotum is cumbersome and unsightly and sexual

relations become impossible. Gangrene may supervene abscesses sometimes form eczema or ulcerations may occur and varices may rupture, allowing escape of lymph

Associated conditions due to filariasis and accompanying infections are orchitis hydrocele lymphangitis abscess varicose glands arthritis synovitis elephantiasis and lymph varices elsewhere, especially in the legs chyluria chylocele chylous ascites and chylous diarrhea caused by rupture of varicose lymphatics in the urinary tract tunica vaginalis, peritoneum and intestinal tract

Diagnosis.—The larval forms of the *Filaria sanguinis hominis* are commonly present in the lymph of the varices of lymph scrotum and may be found in the blood. Because the adult worms have usually died it is rare to find microfilariae in the blood in elephantiasis. Indeed in filarial countries a smaller percentage of people with elephantiasis than of those without elephantiasis have these parasites in the blood. However they should be looked for microscopically, using thick preparations made at night. These may be studied fresh or after being dried and stained (without fixing) for one hour in weak carbol fuchsin (4 drops of saturated alcoholic solution to 1 ounce of water). In some cases the blood shows an eosinophilia and with the acute conditions a leukocytosis. An associated lymphangitis, with its constitutional symptoms, is suggestive. A history of residence in tropical or sub-tropical climates is generally elicited.

Lymph stasis due to other causes may give the picture of lymph scrotum and an added infection may cause an actual elephantiasis. However the scrotal condition would be accompanied or even overshadowed by other symptoms which with the history usually lead to a correct diagnosis of the true causal factors (see later).

Prophylaxis.—The life-cycle of the *Filaria bancrofti* can be completed in neither man nor mosquito but only by passage of the parasite from one to the other. One human being cannot contract filarial disease from another but becomes infected only by the form of the parasite developed in the mosquito. Prevention of filariasis and its many consequences hinges on the elimination of the mosquito. Its breeding places should be dealt with according to methods now generally known in civilized communities. Individuals harboring filariae and all uninfected people in tropical climates should be carefully protected from mosquitoes. It is possible though not proved that water to which mosquitoes have had access may convey the parasite. Hence all drinking water in the tropics should be boiled.

Treatment.—While simple lymphatic edema may subside it seems generally recognized that lymph scrotum and elephantiasis do not recover spontaneously. They may remain stationary for years or recede somewhat in bulk after an attack of lymphangitis, but such scrota never again become normal.

The cure of filariasis involves the destruction of the adult parasites. No known drug is efficient to this end. The worms often die after plugging a lymph trunk especially after lymphangitis and thus a

of these 9 cases had had earlier operation for hydrocele. They think lymph-scrotum is due to an outpouring of lymph from about the testicles, faster than the lymphatics of the scrotal wall can carry it away. The skin of lymph scrotum is soft and silky and on inspection presents evident varices. Microfilariae are usually present in the lymph locally. Often the inguinal and femoral glands are enlarged. Erysipelatous inflammation is a frequent complication. Lymph scrotum may remain such or become elephantiasis which, according to hitherto prevalent views, is the combined result of lymph stasis and recurrent inflammation. However, recent experimental work by Drinker and his collaborators indicates that some degree of elephantiasis may ensue without inflammation, although inflammation hastens and exaggerates the process (see later). A lymph scrotum may become large, but not excessively so, as may be the case with elephantiasis. Lymph stasis alone causes varices and edema with perhaps some tissue hypertrophy, but clinically the sequence of events in filarial elephantiasis is lymph stasis (from causes already given), lymphangitis (usually due to streptococcus), imperfect absorption of the inflammatory products, and gradual, intermittent, progressive, inflammatory hypertrophy. The derma becomes dense, fibrous, and enormously hypertrophied. The connective tissue is increased in bulk and has a blubbery appearance, on section there is a free oozing of lymph. Blood-vessels are enlarged and lymphatics dilated.

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The general health may be excellent except during the attacks of inflammation. The scrotum is cumbersome and unsightly and sexual

cular cut. A circular incision is made about the preputial opening and the tube of skin running to the glans penis is saved if it is healthy. A hydrocele or hernia may now be repaired if the case is a clean one. Finally the diseased mass is entirely cut away and bleeding vessels clamped as encountered. The skin hanging from the glans penis is inverted and usually suffices to cover the shaft of the penis. Otherwise the raw surface of the penis may be covered at once with Thiersch grafts obtained from the thigh. By loosening the edges of normal skin about the wound there is found enough to construct a new scrotum. A drain is left in the perineum. Care is needed during the operation to avoid the dorsal vein of the penis and also the bulb of the urethra which is pulled downward by the mass. Two cases of concomitant epithelioma of the penis have been reported in the literature. The condition would necessitate, in addition to the scrotal operation amputation of the penis and careful dissection of the inguinal groups of glands.

The knees are kept tied together for some days after operation. Annoying erections are best controlled by an ice-bag.

Wise and Minett²⁴ in enumerating the situations where adult filariae alive or cretified have been found report them in the inguinal glands in 25 cases. This would make it appear wise to remove the inguinal glands of patients who are in good condition if there be larvæ present in the blood before operation and elephantiasis of the scrotum is the only other evidence of filariasis.

ELEPHANTIASIS OF NON-FILARIAL ORIGIN

An important report of experimental work²⁵ by Drinker, Field and Homans controverts the generally accepted view that lymphatic obstruction causes edema only and that infection (streptococcus) is necessary to produce hypertrophy of the skin and underlying tissues—elephantiasis. They call attention to Reichert's unsuccessful attempts to produce prolonged edema in dogs by severing all lymph channels in a limb because the lymphatic circulation would regenerate in four or five days. But Drinker and his collaborators operated by repeated attacks exposing lymph trunks in a dog's hind leg seven or eight times at intervals of one or two weeks and injecting them slowly with water suspensions of crystalline silica followed by 2 per cent aqueous solution of quinine hydrochloride. After observing a series of such experimental animals they state that following lymphatic block, and what at their worst are very transient periods of sterile irritation the part becomes characteristically elephantiasis. Infection is not necessary in order to bring this about but if infection occurs the elephantiasis develops much more rapidly. A possible explanation is seen in the fact that the tissue fluids in experimental lymph edema acquire a high percentage of protein. Inasmuch as such a medium provides an excellent growth of connective tissue cells *in vitro* it seems plausible that this excessive protein in the tissue fluids

spontaneous cure of the active infection may occur. But the numerous sequelæ of the obstruction remain. When the site of the entrapped worm is surgically accessible, operation may really cure the disease. But the location of the parasite cannot often be diagnosed during life. When scrotal involvement is the only sign of filariasis it seems probable that the worm is in the inguinal glands. Pruniose³² reported a case cured clinically and according to blood examination by surgical removal of part of the scrotum in which the adult worm was found. Cunningham⁶ operated for elephantiasis, did not find any filaria in the specimen removed, but larval forms were found in the blood before operation and none afterward, the patient was clinically well at the end of twenty months when the case was reported.

Lymph scrotum should be kept clean and dry and a well-fitting suspensory worn. Chyluria and elephantiasis of the leg have followed surgical intervention. If anything is attempted, a complete excision is the best procedure.

Lymphangitis and fever are treated by confining the patient to bed, elevating the scrotum, and applying ice-bags or, better, cold compresses. Morphine may be necessary to relieve pain. The bowels are kept open, light diet given, and a copious quantity of water should be taken.

Elephantiasis of the scrotum, if small and not burdensome, had better be merely guarded against injury, or perhaps bandaged tightly. If large, excision is not only feasible but advisable. In parts of India this is one of the commonest of operations. One surgeon reports having removed "over a ton" of scrota! The immediate and remote results are good as regards comfort and sightliness and the patient's working efficiency. Attacks of fever often cease after operation. Coitus and procreation become possible. The general mortality of the operation is a trifle over 5 per cent. Charles,⁶ Maitland,²³ Murray,²⁷ and Calvert⁴ have reported (totaling their cases) 560 operations of excision of the scrotum for elephantiasis with only 6 deaths. Charles had a series of 140 consecutive unselected cases without a death and Calvert a series of 151.

The operation is preceded if possible by elevation of the scrotum (sometimes with compression as well) and frequent cleansing for two or three days. Erosions or ulcerations of the skin should be healed before operation. The usual preoperative preliminaries of examination and preparation are to be observed. The patient is placed in the lithotomy position. A figure-of-eight tourniquet (around waist and base of scrotum) used to control bleeding was advised by older writers, but more recently the consensus of opinion is against such a device. All are agreed on the essentials of the operation, to first isolate the penis and spermatic cords and testicles through three longitudinal incisions over these structures, then excise *all* the involved scrotal tissue. Connell⁷ first cuts all around the neck of the tumor in healthy skin, elevates the proximal edge and controls bleeding immediately by packing with gauze and later with clamps, then isolates the penis and spermatic structures through small incisions just below the cir-

cular cut. A circular incision is made about the preputial opening and the tube of skin running to the glans penis is saved if it is healthy. A hydrocele or hernia may now be repaired if the case is a clean one. Finally the diseased mass is entirely cut away and bleeding vessels clamped as encountered. The skin hanging from the glans penis is inverted and usually suffices to cover the shaft of the penis. Otherwise the raw surface of the penis may be covered at once with Thiersch grafts obtained from the thigh. By loosening the edges of normal skin about the wound there is found enough to construct a new scrotum. A drain is left in the perineum. Care is needed during the operation to avoid the dorsal vein of the penis and also the bulb of the urethra which is pulled downward by the mass. Two cases of concomitant epithelioma of the penis have been reported in the literature. The condition would necessitate in addition to the scrotal operation amputation of the penis and careful dissection of the inguinal groups of glands.

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FIG 245

FIG 246

FIGS 245 and 246 —Non-filarial elephantiasis with involvement of scrotum and penis. This patient had repeated attacks of streptococcus cellulitis over a period of many years. Cure followed extensive removal of involved tissue by operation.

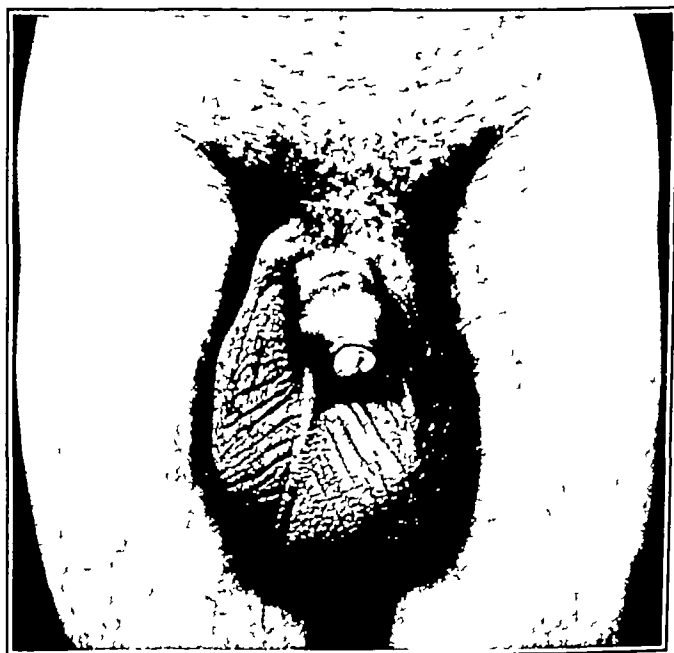


FIG 247 —Non-filarial elephantiasis in man, aged twenty-seven years. Enlarged scrotum present eighteen months, not painful nor tender. Native of France, had lived nowhere else except United States. Wassermann reactions negative. Many negative searches for microfilariae. Successful result followed excision of scrotum.

may have a causal relation to elephantiasis. Where edema fluids low in protein exist, tissue growth does not occur apparently the addition of protein and possibly of disintegrating cells is necessary for such growth (these changes are an essential accompaniment of inflammation). Indeed in the experimental animals the investigators find an overgrowth of connective tissue with dilatation and thickening of lymphatic capillaries after lymphedema has been present two months. When a part loses lymph drainage permanently there develops a marked susceptibility to streptococcus infection. But we repeat that the authors regard attacks of infection as not the essential cause of connective-tissue growth, although they do greatly accelerate such growth.

Lymphedema and elephantiasis of the scrotum not due to filariasis are not rare. Indeed most of such swellings met with in northern climates fall into this group. These swellings are small when compared to those due to filariasis.

A classification²² offered by F. V. Allen of 300 cases of lymphedema of the extremities seen at the Mayo Clinic is helpful in considering similar scrotal conditions.

ALLEN'S CLASSIFICATION OF LYMPHEDEMA OF THE EXTREMITIES.

A. <i>Non-inflammatory</i>		
1. Primary		Cases.
Precox		93
Congenital		
(a) Simple		12
(b) Familial (Milroy's disease)		0
2. Secondary		
Malignant occlusion		32
Surgical removal of lymph nodes		61
Pressure		1
Roentgen-ray and radium therapy		3
B. <i>Inflammatory</i>		
1. Primary (single or recurrent acute and chronic)		41
2. Secondary (single or recurrent acute and chronic)		
Venous stasis		13
Trichophytosis		8
Systemic disease		5
Local tissue injury or inflammation		34

One occasionally encounters typical scrotal elephantiasis with no demonstrable cause for the lymph block in individuals whose lives have been spent in the temperate zones. In fact Cougerot and Blum²³ report elephantiasis of the extremities in patients living in the tropics, with no evidence of filariasis presumably similar scrotal conditions are encountered. Nesbit²⁴ calls attention to occasional congenital elephantiasis of the limbs of unknown etiology but no description of a similar congenital condition of the scrotum has been found. There are reported instances of elephantiasis of the scrotum following lymph block due to surgical removal of the inguinal lymph glands, to scar formation to infection and to tuberculosis of the pelvic lymph nodes. A slight degree of elephantiasis may occur with ulcerating granuloma of the genitalia. A similar condition has been referred to syphilis with superimposed streptococcus infection. McDonagh²⁵ reported

such a case in which the circumference of the scrotum was reduced from 28.5 to 13.5 inches by mercurial treatment

For emphasis, attention is again called to the fact that these non-filarial scrotal elephantiasis enlargements never reach the extreme size of the old filarial cases. However, the local treatment is the same—complete excision of all morbid tissue if the size of the scrotum demands any interference

NEOPLASMS OF THE SCROTUM

New growths of the scrotum are relatively uncommon. The least uncommon is epithelioma, referred to in earlier literature as “chimney-sweeps’ cancer” because all of the cases first recognized occurred in chimney-sweeps. Later similar cancers were found in workers in tar and paraffin. In 1910 Wilson³⁹ first described these growths in cotton



FIG. 248—Cancer of the scrotum

workers, especially mule-spinners. They occasionally occur also nowadays among the employees of dye-works. Carcinoma of the scrotum is a great rarity in America, and has been more frequently seen in England than elsewhere. Morley²⁶ found records of 30 cases at the Manchester Royal Infirmary from 1906 to 1910, and during that period (for comparison) only 25 of carcinoma of the penis.

Butlin³ showed years ago by interesting statistical data that the irritation of soot and coal-tar products was a marked predisposing etiological factor. While friction from clothes may have an influence, the long contact with oil is still believed to be of paramount importance. Leitch²¹ has published suggestive experiments on mice. On the other hand, Robertson³⁴ believes dirt and friction from clothes are more important than oil in etiology.

Cancer begins as one or more warts apparently remaining benign for years or as a superficial, painful, ragged vascular ulcer with a scab on its surface and with indurated base and edges, situated usually on the lower part of the scrotum more commonly on the left side. Histologically it is a true epithelioma. Clinically it is slow growing. Glandular involvement is relatively late and metastasis to other organs is uncommon. If untreated the growth may gradually involve testicles, perineum and penis. It is apparently not responsive to radiotherapy. A few cases have been so treated at the Memorial Hospital, New York City without success.¹¹ Surgery offers the best outlook—through excision of the scrotum and dissection of the inguinal and femoral glands, preferably in one mass (see paragraph on lymphatics of the scrotum). Unless adherent the testicles and cords should not be removed.

Adenocarcinoma metastasis in the scrotum has been reported. Instances of primary melanosarcoma cavernous hemangioma lymphangioma fibroma lipoma lipo-mixto-fibroma chondroma osteoma large gumma actinomycosis, hydatid cyst atheromatous cyst and dermoid cyst of the scrotum have been recorded. Wesson¹² reported a case of spindle-cell sarcoma favorably treated by surgery and radium and Oudard¹³ one of lymphosarcoma of the scrotum which subsided following roentgen ray exposures. But the treatment of most neoplasms of the scrotum is surgical.

Rubaschow¹⁴ in discussing the origin of certain tumors of the scrotum suggests that many of the non-epithelial growths even lymphangiomas may arise from tissues originally retroperitoneal which have been drawn down into the scrotum with the descent of the testicles.

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CHAPTER VII

HYDROCELE, HEMATOCELE SPERMATOCYCLE AND VARICOCELE

By HENRY L. SANFORD, M.D., F.A.C.S.

HYDROCELE

Definition.—Hydrocele in its ordinary form is an abnormal accumulation of serous fluid in the cavity of the tunica vaginalis. Normally a few drops of fluid are present between the visceral and parietal layers of the tunica as a protection to the testis.

Other forms of hydrocele represent collections of fluid contained in other structures than the cavity of the tunica vaginalis, either communicating with it or distinct from it. A brief reference to the embryological development of these structures will aid in explaining the origin of these other types.

Anatomy—Before its descent into the scrotum the testis is a retroperitoneal abdominal organ and has no direct relation with the true abdominal cavity. As it descends on the gubernaculum testis it carries with it the anterior covering of peritoneum, which is to become the visceral layer of the tunica vaginalis and as the testis passes through the internal ring and the inguinal canal it pushes before it a pouch of parietal peritoneum which is called the processus funicularis and which in turn becomes the parietal layer of the tunica vaginalis.

In the scrotum the visceral layer of the tunica after covering the testis, passes over onto the epididymis, which it includes between its two leaves, and is then reflected onto the parietal layer of the tunica. It thus happens that the posterior inner border of the testis where it is apposed to the epididymis has no peritoneal covering and so it maintains its original retroperitoneal character.

After this complicated migration of the testis is completed a door is shut after it to hold it in position. If this door does not close soon after birth or in other words, if the cavity of the funicular process of peritoneum through which the testis descended does not become obliterated conditions are present which admit of various abnormalities. Among them are some of the types of hydrocele to be considered.

Varieties.—Hydroceles may be classified* according to their anatomical location into

1. Hydrocele of the testis.
2. Hydrocele of the cord.
3. Complications of 1 and 2.
4. Hydrocele of a hernial sac.

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tuberculosis of the epididymis are the two infections which most often produce symptomatic hydrocele the former a very acute type the latter tending to a more chronic course. Other causes which may produce this form of hydrocele are infections by the pneumococcus, the colon bacillus, by typhoid erysipelas rheumatism syphilis and neoplastic growths

Course.—The course of acute hydrocele corresponds to that of its cause it tends to recovery as the primary disease improves and becomes chronic as the cause persists. The exciting factor may entirely disappear however and leave behind it a persistent hydrocele

Symptoms.—The symptoms of acute hydrocele depend on the virulence of the infecting agent. *Pain* may be severe or absent. In acute gonorrheal epididymitis the tension of the complicating hydrocele is often responsible for a considerable part of the severe pain as is shown by the remarkable relief which follows the release of the fluid in epididymotomy. The hydrocele accompanying tuberculous epididymitis on the contrary rarely causes any discomfort. The *sac* of an acute hydrocele may be *obliterated* by plastic exudate or *suppuration* may occur in it.

Diagnosis.—The diagnosis may be made by the means to be described under the chronic type

Treatment.—The treatment is usually *palliative*. If the causative infection runs a short acute course and the amount of fluid is small with *rest elevation* of the scrotum and *hot moist dressings* the effusion may be left to absorb. Severe pain with considerable fluid demands *aspiration* which may be repeated if necessary.

Suppuration requires *incision* and *drainage*. None of these measures is curative and the treatment of the underlying condition is the proper treatment for the hydrocele. Injection of the sac is usually unsuccessful in this type of hydrocele and should not be done. When the fluid fails to be absorbed after some weeks, the hydrocele becomes chronic.

Chronic or Idiopathic Hydrocele.—**Etiology.**—Persistence of an acute hydrocele is a common cause of the chronic type. This occurs especially after infections of the testis and epididymis which tend to run a chronic course. Cases of *primary disease of the tunica vaginalis* have been reported as the cause of chronic hydrocele without being secondary to diseases of the testis or epididymis. Hildebrand⁴ described a gumma of the tunica vaginalis and De Vlaceos² cases of tuberculosis of the tunica. The latter considered the hydrocele analogous to a tuberculous ascites, and believes that the tuberculosis originated in the abdomen with transmission of infection through an open processus funicularis settling at its lowest point.

Certain *congenital* hydroceles are *tuberculous*. They appear at birth or shortly after in infants of tuberculous mothers showing a placenta-borne infection. These children rarely live and die of a tuberculous bacillema.

According to Cartier 25 per cent of supposedly idiopathic hydroceles in adults are *tuberculous*. In a study of 86 cases of hydrocele

1. *Hydroceles of the testis include* (A) those of the *tunica vaginalis*, where the fluid is in a sac directly connected with the *tunica vaginalis*. Of these there are four forms

(1) The *ordinary* type, distending the closed *tunica vaginalis*,

(2) The *congenital* type, where the sac of the *tunica vaginalis* communicates directly with the abdominal cavity, due to complete failure of the *processus funicularis* to close,

(3) The *infantile* type, in which the sac of the *tunica vaginalis* and a portion of the *processus funicularis* are filled with fluid, but no connection exists with the abdominal cavity, representing partial failure of closure of the *processus funicularis*, and

(4) The *inguinal* type, a hydrocele in relation to an undescended testis

(B) *Encysted hydroceles of the testis*, in which the fluid is in a sac distinct from the *tunica vaginalis*, as in *encysted hydroceles of the epididymis* when the fluid is contained between the two layers of visceral tunica as it passes from the testis over onto the epididymis, and *encysted hydroceles of the testis*, where the fluid is between the tunica albuginea and the visceral layer of the tunica. These are rare types

2 *Hydroceles of the cord* may be of the *diffused* type, a serous collection of the nature of edema in the cellular tissue of the cord, or of the *encysted* type, fluid in a distinct sac originating either from some unobliterated portion of the *processus funicularis*, or from a cyst formed independently of this process, by dilatation of persistent tubules of the organ of Giralde. In women a collection of fluid in an unobliterated *processus funicularis* is termed *Hydrocele of the Canal of Nuck*

3 *Complications* of these forms of hydrocele represent any two forms coexisting or any form occurring with hernia. An example of this type is the so-called abdomino-scrotal or inguino-scrotal form of hydrocele to be described later in this chapter

4 *Hydrocele of the sac of a hernia* may occur by the effusion of fluid into a hernial sac, the contents of which have been reduced with subsequent obliteration of the neck of the sac

Hydroceles may also be considered according to their course as *acute* and *chronic*, and as to their origin as *symptomatic* and *idiopathic*. While all idiopathic hydroceles are chronic it is not equally true that all symptomatic hydroceles are acute

Acute Hydrocele.—Acute hydrocele is the direct sequel of inflammation and infection of the testis and epididymis and occasionally follows trauma

Traumatic hydroceles in the new-born usually contain some blood and may show ecchymosis of the scrotum. They are often absorbed. In adults, trauma as an etiological factor is a disputed question. Certain authors give 25 to 50 per cent as due to trauma, others state that only those cases accompanied by ecchymosis and definite signs of injury can be so considered

The cavity of the *tunica vaginalis* is filled with a varying amount of fluid which may be *serous*, *fibrinous* or *purulent*. Gonorrhea and

sediment in case of old hemorrhage. It contains about 6 per cent of albumin made up of serum albumin and globulin with some fibrinogen. Glucose has been found in it. It differs from ascitic fluid by containing salts and fibrin. Occasionally on opening a hydrocele there are found in the fluid *fibrous bodies* about the size of a pea which are concretions of earthy phosphates or carbonates covered with fibrin. Keyes¹⁷ believes they probably originate as deposits of hydrocele salts on some warty growth on the sac wall, which later breaks off and becomes free in the fluid.

Microscopic examination of the fluid shows some endothelial cells, a few leukocytes, cholesterol crystals and in many cases spermatozoa. Bacteria are present in infected cases, and blood if there has been spontaneous or traumatic hemorrhage from the sac wall or testis. There are often seen glistening drops which have been considered fat drops but



FIG. 219.—Idiopathic hydrocele

which Posner²¹ thinks are lipoids, analogous to the lecithin bodies of the prostate. He believes these bodies impart motility to the spermatozoa as does the lecithin of the prostate. The presence of spermatozoa is explained by the supposition that a rupture of semen preparing tubules has occurred into the hydrocele sac and that a communication between these tubules and the sac must continue to exist. If this is true the cholesterol crystals found in hydrocele fluid may be accounted for as coming direct from the testis.

Winslow reports 6 cases in which spermatozoa were found in hydrocele sacs under different conditions. One case was a man aged eighty-three years who had a large hydrocele on the right side for thirty years. Aspiration yielded 900 cc. of whitish fluid containing many motile spermatozoa. [It may fairly be doubted whether this was in fact a case of hydrocele. The fluid withdrawn was that of a spermatocele which may have been of the intravaginal type.—EDITOR.]

From Caforio's² study of hydrocele fluid he believes it to be an *exudate* of bacterial origin rather than a *transudate* from chronic passive

in which there was no lesion of the testis or epididymis, the fluid recovered by puncture showed tubercle bacilli in 29 per cent, and in 8 of these tuberculosis was produced in guinea-pigs

Congenital *sypilitic* hydrocele may be single or double. The infant's blood and hydrocele fluid may both show a positive Wassermann reaction. Both may be negative, and the mother's blood positive. Under antiluetic treatment these hydroceles are usually absorbed.

Trauma is considered a cause of chronic hydrocele. In this way the frequent occurrence of hydrocele among circus-riders is explained. Injuries at birth have been held responsible for certain instances of congenital hydrocele.

Recent statistics have noted an unusually large number of hydroceles occurring as a postoperative complication following resection of veins in varicocele. (See under Varicocele.)

Besides all these cases, however, to which an etiological factor may be assigned, there still remains a large number of hydroceles the cause of which is not known, and to which the term *idiopathic* is given. These cases are seen frequently in tropical countries, especially India and Egypt, and various investigators have adduced different reasons for their occurrence. Madden¹ believes this type is due to loose tropical clothing, which allows greater trauma to the testis, and to oriental sexual excesses, both of which tend to hyperemia and serous exudate. Pfister¹ thinks there is a connection between bilharzia and hydrocele, while Salm¹ claims to have found filarial embryos in six out of twelve East Indian hydroceles. Others have not confirmed this. Some chronic irritation of the local circulation is believed by many to be the probable causative factor.

Chronic hydrocele differs from varicocele in that it shows no predilection for either *side*, and it often is *bilateral*. All *ages* are subject to hydrocele. Posner,²⁴ however, is impressed with the number of hydroceles he has met with in old men in association with prostatic hypertrophy, and believes it is a possible cause of the idiopathic type.

Pathology — The pathology of hydrocele involves a study of the *fluid*, the *sac*, and the *effects*, if any, of the presence of the hydrocele on the *testis* and *epididymis*.

The Fluid — Amount — The hydroceles one sees today contain from 4 to 10 ounces of fluid. Patients, unless they come from remote districts, rarely allow them to get larger without seeking relief. Before the days of surgical asepsis, operations were regarded with considerable dread, and cases of enormous size are on record. Mursenna (1796) reported a case where the sac measured 17 by 27 inches, Leigh, in 1607, one where the tumor weighed 120 pounds, and Casper, a case in which the sac held 5 gallons.

Physical and Chemical Properties — Hydroceles in simple uninfected cases contain a clear serous liquid resembling blood serum. It is of a straw or greenish-yellow color, the reaction is neutral, its specific gravity varies from 1020 to 1026, and it has no odor. The fluid is cloudy if infected, and may be brownish-red with a coffee-ground

sediment in case of old hemorrhage. It contains about 6 per cent of albumin made up of serum albumin and globulin with some fibrinogen. Glucose has been found in it. It differs from ascitic fluid by containing salts and fibrin. Occasionally on opening a hydrocele there are found in the fluid *fibrous bodies* about the size of a pea which are concretions of earthy phosphates or carbonates covered with fibrin. Heves¹⁷ believes they probably originate as deposits of hydrocele salts on some warty growth on the sac wall which later breaks off and becomes free in the fluid.

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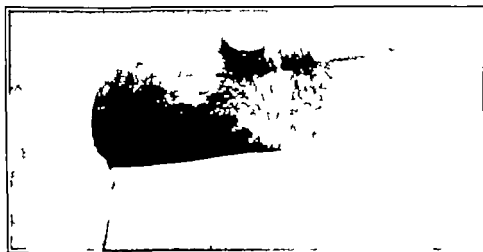


FIG. 249.—Idiopathic hydrocele

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From Caforio's²² study of hydrocele fluid he believes it to be an *exudate* of bacterial origin rather than a *transudate* from chronic passive

congestion, otherwise he would expect hydrocele more often to complicate varicocele, and *vice versa*. He finds also that transudates in general have a lower specific gravity and smaller albumin content than hydrocele fluid.

The Sac --The cavity of the sac in hydrocele may be *single* or *multilocular*. Adhesions between the layers of the tunica may be formed as a result of fibrinous exudate subsequent to infection or irritant injections producing partial obliteration. In hydroceles of long standing the sac wall is usually much thickened. This appears especially about points of puncture from previous tapping. Calcification may occur in localized areas.

Rare cases of *traumatic rupture* of the tunica vaginalis in hydrocele have been reported. This implies a diseased condition of the tunica. These cases are accompanied by pain, shock, hematocele and ecchymosis of the scrotum. If untreated and no severe hemorrhage takes place, absorption may take place and the hydrocele refill. Gangrene and septicemia have occurred. In such cases the scrotum should be opened, and blood clots removed as well as the parietal layer of the tunica unless adhesions prevent.

The Testis and Epididymis --Primary disease of these organs in many cases is the cause of the hydrocele, but they may also suffer as a result of the presence of the hydrocele. Pressure of the fluid on the testis and thickening of the connective tissue about it has produced atrophy and loss of function of the organ. The epididymis may also be involved.

Symptoms. - The *objective* symptoms of hydrocele are those of a pear-shaped tumor of one or both sides of the scrotum, the larger portion below, and the smaller above, sharply tapering into the cord. It is smooth in outline, elastic to the touch, dull to percussion, and translucent to light. It cannot be reduced into the inguinal canal, and gives no impulse on coughing unless complicated with hernia. In hydroceles of large size the skin of the scrotum is tense and glazed, but shows no redness or edema and is movable over the tumor. The cord leading to the hydrocele is normal in size. The growth of the tumor is slow, enlarging gradually from the bottom of the scrotum toward the inguinal canal. The testis is usually situated behind and somewhat below the center of the tumor, very rarely it is at the front, and then only as the result of adhesions.

Subjectively chronic hydroceles rarely cause any pain or tenderness unless some complicating infection is present. The fluid gathers slowly and may reach some size before the patient notices it. Hydroceles do, however, produce discomfort from their weight, and if of a large size, invagination of the penis into the encompassing tumor makes urination difficult with attendant excoriation of the skin by the urine. Coitus may be interfered with either because erections are poor or because the outflow of semen is obstructed. Cases are on record in which spermatozoa were absent in the semen when the hydrocele was distended, but reappeared after tapping. Prostatists who have hydrocele are sometimes hard to catheterize.

Diagnosis.—*The Light Test*—The property possessed by simple hydrocele of transmitting light through its fluid contents is the means most often invoked in making a diagnosis. If the observer looks through a hollow tube held tightly against one side of the hydrocele while an electric light bulb or other source of light is held against the opposite side a pinkish light will be seen glowing through the tumor and a darker shadow cast by the more solid testis may sometimes be made out. This test often fails when the contents of the hydrocele are cloudy when its walls are thickened and in the presence of adhesions or multilocular cyst formation. Translucency is also a characteristic of some soft tumors of the testis when a portion of the contents is fluid; it is observed in some hernias in infants and in some hydatid cysts. This method of diagnosis therefore is by no means infallible.



FIG. 250.—Hydrocele. Diagnosis by transillumination.

Unless it extends up into inguinal canal a hydrocele is sharply defined at its upper border into which the cord of normal size passes.

Puncture of the hydrocele and recovery of the typical fluid is the surest means of diagnosis. It should never be done however unless the presence of hernia can be absolutely ruled out.

A cytological examination of the aspirated fluid does not always give an idea of the causative factor of the hydrocele, but many authors are agreed that the presence of a large percentage of mononuclear leukocytes is strong evidence of a tuberculous hydrocele.

Besides these methods the history of the slow gradual development of a painless tumor is of aid in making a diagnosis.

Differential Diagnosis.—Hydrocele must be differentiated from hernia spermatocele hematocele chylocele solid tumors of the testis and gumma.

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Treatment.—Historical—There is scarcely a disease for the cure of which physicians for centuries have devised more numerous or more ingenious methods of treatment than for hydrocele. Until anatomists of the time of Monro, Hunter and Pott discovered the true nature of hydrocele there was 'supposed to be an immediate connection between the coats of the testicle, liver, kidneys and other viscera and the collection of water in hydrocele was considered a deposition from these parts tending to free them and perhaps the system at large from diseases of importance. Various kinds of internal medication were accordingly used with local applications in the form of counter irritants. Simple tapping of the hydrocele was a very early measure. Electricity and electropuncture were employed on the principle that the current acted as a counter irritant and also possessed some coagulating power on albuminous fluids. The injection of irritant fluids into the sac following aspiration was among the earliest methods of treatment, and is still used today. Among the fluids which have been used are wine, various acids, iodine, chlorine, zinc chloride, alcohol, ether, chloroform, adrenalin, bichloride of mercury, ferric chlorate, chloral hydrate, ergotin and silver nitrate. The introduction of foreign bodies into the sac after aspiration has also been extensively practised with the idea that the injection of an irritant fluid had too transitory an effect to produce complete obliteration of the sac. Some of the substances used have been rubber tubes, silk, catgut²² and metal strips.²³

Vaccine therapy has been used in hydrocele. Mallanah²⁴ reports cures of 6 cases in which an injection of from 5 to 10 million of either B. pyocyaneus or Staphylococcus aureus vaccine was made into the hydrocele sac after aspiration of the fluid. Severe reaction occurred followed by increase in size of the hydrocele, later regression to a cure.

Autoserotherapy in the treatment of hydrocele consists in total or partial aspiration of the sac followed by subcutaneous or intramuscular injection of the patient with his own fluid. This has been extensively practised in recent years by foreign investigators but there is little American literature on the subject. This method is analogous to similar work which has been done in tuberculous exudates of the pleura and peritoneum. The amount of fluid injected varies with different workers from 1 to 20 cc. with an average dose of 5 cc. The size of the dose is reported to make little difference in the amount of local reaction or the effect on the hydrocele. Injections are made either in the thigh, buttock or abdomen. Most authors who have tried this procedure have reported a rapid absorption of the fluid in the hydrocele following the autoserotherapy. The absorption takes place within the first twenty-four hours and then remains stationary. There is seldom local reaction or fever. In most cases relapses occur sometimes immediately but not later than two months. These cases require several reinjections.

In 73 cases Caforio²⁵ reports that absorption of the fluid in the hydrocele took place in 96 per cent. Relapses occurred in 80 per cent but by continuing the injections 42 per cent were permanently cured, as

Hernia gives an impulse on coughing, is tympanitic to percussion and is reducible unless incarcerated or strangulated. In the latter case the previous history of a reducible tumor with the recent acute symptoms would prevent confusion in diagnosis. It must always be remembered, however, that hydrocele and hernia often coexist, especially in children.

Spermatocele is differentiated by its rarity, by the fact that the testis is usually in front and below, instead of behind as in hydrocele, and by the predominance of seminal elements in the fluid contents on aspiration. The differential diagnosis is impossible, however, in the intra-vaginal type of spermatocele, which can only be identified at operation.

Hematocele can usually be distinguished by the recent history of injury, by its solid and inelastic feel, by the opacity of its contents, and by the presence of skin ecchymoses. A hydrocele may be converted into a hematocele by spontaneous or traumatic hemorrhage from the sac wall, the latter sometimes follows aspiration of a hydrocele, if the trocar wounds a vessel in the sac.

Chylocele is characterized by its occurrence in the tropics, its parasitic origin, and by the creamy character of the fluid, which shows a layer of fat at the top on settling.

Solid tumors of the testis differ from hydrocele in their rapid growth associated with pain, in their non-elastic feel, with absence of fluctuation, and the development of inguinal glands. There is frequently enlargement of the cord leading to the growth.

Gumma of the testis presents a painless, hard, doughy mass which does not permit transillumination. The Wassermann reaction is positive.

Prognosis.—In *children* cures of hydrocele may occur spontaneously and occasionally after a single tapping. For this reason certain authors advise expectant treatment with children. Other authors find hernia complicating hydrocele in infants so frequently that they recommend early radical cure of both conditions.

In *adults* chronic hydrocele shows no tendency to spontaneous recovery. It never endangers the patient's life except under the rarest complications of hemorrhage and infection. The percentage of cures under the various methods of treatment is discussed under that heading.

Complications—Two or more forms of hydrocele may coexist, and hernia frequently accompanies hydrocele in children. *Suppuration* is uncommon in chronic hydrocele. *Rupture* of the hydrocele sac is usually regarded as rare, but Hastings¹⁴ believes it a more frequent accident than is commonly supposed. It may occur as the result of trauma or muscular action, rarely spontaneously. The tunica vaginalis in such cases is nearly always the seat of pathological changes, usually with fibrous thickening, and areas of fatty degeneration. A ruptured hydrocele must be differentiated from elephantiasis of the scrotum, from extravasation of urine, and from strangulated hernia. *Hematocele* may be the result of the rupture of the sac. Rupture only rarely results in a cure, usually the hydrocele refills, unless the cavity of the sac is filled with blood clots.

out of the cavity of the tunica vaginalis into the space between it and the skin during the withdrawal of the fluid as this results in infiltration of the scrotum. A colloidion dressing of the puncture wound and a suspensory complete the aspiration.

In old men with large hydroceles a partial removal of the fluid is wise followed later by withdrawal of the remainder. Congestion and hemorrhage have been reported following too great changes in local conditions after the complete aspiration of a large sac.

After tapping the hydrocele usually refills in from two to six months. Many patients are content with a semi annual relief of their burden over a period of many years.

Complications—The trocar may wound the testis when it has been pulled out of its usual posterior position by adhesions. This rarely produces any serious trouble. Hemorrhage from the sac wall due to puncture of a vessel of some size by the trocar may produce hematocele. Both of these accidents may be avoided by transillumination of the sac in selecting a point of puncture. The course of bloodvessels and the position of the testis are thus made clear.

ASPIRATION AND INJECTION—This ancient method of treatment seeks to produce obliteration of the cavity of the tunica vaginalis by the injection into it of an irritant following the aspiration of the fluid. It was practically abandoned as a result of the severe reactions, in some cases resulting in abscesses and sloughing which followed the injection of too irritating solutions and their repeated failure to obliterate the sac.

In recent years however investigators have brought forward injection solutions which seem to produce excellent results without the disadvantages of the earlier ones. Kilbourne and Murray¹¹ state that the ideal fluid for the injection of a hydrocele should produce no pain or disability it should be non-toxic bactericidal to prevent infection efficient to prevent recurrence and without danger of producing hemorrhage.

Of the newer solutions which have been recommended various combinations of quinine and urea have proved most successful.

Indications—This procedure is indicated in a restricted class of cases, namely in simple uncomplicated hydroceles when the fluid is clear and the sac wall unchanged. It is not adapted for congenital hydroceles, for symptomatic hydroceles with accompanying disease of the testis or epididymis for hydroceles in which the sac wall is indurated infected or calcareous, for multilocular hydroceles, nor for hydroceles complicated with hernia.

Technique—The technique of the newer method consists in infiltrating the skin of the scrotum with novocaine at the point selected for aspiration. An 18-gauge needle is then introduced into the hydrocele, and the aspirated fluid examined under the microscope for or pus. The hydrocele is thoroughly emptied and the scrotal contents palpated for evidence of tuberculosis or tumor. Taking care that the needle is still free in the cavity of the tunica, 2 to 4 cc. of a solution of

shown by absence of relapses over periods varying from several months to years. The injection of hydrocele fluid from other patients (heteroserotherapy) produced no effect. Investigators are not agreed as to how this method produces the results claimed, and until the nature of the process involved in the cure is better understood, it must be regarded as only in the experimental stage.

Radical surgical operations on hydrocele have been done for centuries. Incision and drainage of the sac was practised as early as the time of Celsus, who also excised a portion of the skin at the same time. But the tremendous reaction resulting from the infection of the wound made surgery the resort of the more adventurous until the days of cleaner methods.

When Lister introduced the principles of antiseptics, hydrocele was one of the first diseases on which their value was demonstrated. Volkmann, in 1876, gave his name to an operation which consisted in wide *incision* of the sac, swabbing its cavity with carbolic acid and sewing the edges of the sac to the skin with catgut. Permanent drainage was thus secured until obliteration of the sac by granulation took place. Von Bergmann, in 1885, was one of the first to practise *excision* of the sac. Since that time many surgeons have devised changes in the technique of the handling of the sac, and in providing a new bed for the testis.

Present Methods of Treatment — The methods of treatment which need concern us seriously today are two.

- 1 The purely *palliative* procedure of tapping or *aspiration*, and
- 2 The radical operations which seek to obliterate or remove, wholly or in part, the membrane which secretes the serous fluid. These are of two types: (a) The *closed operation* of aspiration and injection, and (b) the *open operations*, consisting in total or partial *excision*, or *eversion* of the sac, or a combination of the two.

SIMPLE TAPPING — *Indications* — Aspiration of the fluid of a hydrocele does not contemplate a cure but merely the relief of symptoms. It is employed when the patient will not consent to a more radical procedure or when some constitutional condition contraindicates any operation. It may be used to advantage in children when the hydrocele is uncomplicated, and at times results in a cure.

Technique — After proper preparation of the skin and after locating the position of the testis the hydrocele is made tense by grasping it from behind between the palm and fingers of one hand. A spot free from large bloodvessels on the lower tense anterior surface of the hydrocele is selected and a sharp medium-sized trocar plunged smartly and quickly into the sac, using one finger firmly fixed on the trocar about $\frac{1}{2}$ inch from its point as a guard against too deep penetration. With a sharp instrument the pain of puncture is slight and only momentary, and often no local anesthetic is needed.

On withdrawing the needle from the trocar, if the fluid does not run through the cannula, it generally means that the point of the trocar has pierced only the skin and not the tunica vaginalis, so that farther insertion is necessary. Care must be taken not to let the cannula slip

the testis through it. The sac is then turned inside out and left without suture or one or more sutures may be passed through the cut edges of the sac, securing it behind the cord to prevent reversion. The testis and everted sac are now returned to the scrotum and the wound closed without drainage. In this operation the convalescence is short and there is little danger of hemorrhage owing to the absence of much dissection. There is seldom any testicular pain and the everted sac soon shrinks. The disadvantages of the operation are that it is not successful in old, thickened hydroceles and that recurrence is not uncommon.

Excision and Eversion (Hinkelmann's Operation) is the procedure accepted today as the best type. After dissecting free the parietal layer of the tunica the sac is trimmed off down to within $\frac{1}{2}$ inch of its visceral

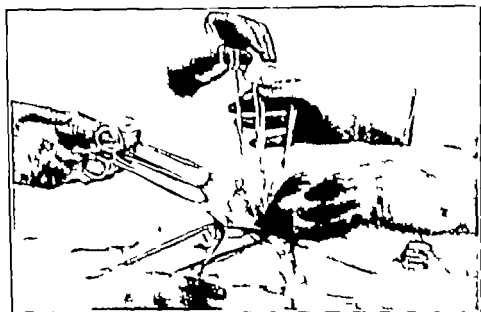


FIG. 231.—Hydrocele. The operator's hand rests on the unopened sac which has been dissected free down to the cord.

insertion and the two cut edges of the parietal stump are sowed behind the testis by a continuous catgut suture. Great care must be taken to secure firmly all bleeding points in the cut edges of the stump of the sac to prevent subsequent hemorrhage. The wound is closed with or without drainage, as may seem best in the individual case, and a support is applied over the dressing.

Bartlett¹ has described a method of total extirpation of the unopened hydrocele. It involves a rather unnecessarily tedious dissection and is suited only to a restricted class of cases. Vautrin¹⁷ believes that in long-standing hydroceles with thickened walls excision with eversion is not enough to prevent recurrence and he makes a new bed for the testis in the connective tissue of the scrotum. This he finds an absolute safeguard against relapse. Volkmann's operation of wide incision of the sac followed by swabbing its cavity with carbolic acid and allowing it

quinine hydrochloride, 13.33 per cent, and urethane, 6.66 per cent, is then injected. The fluid often recurs following the first injection, in which case a second injection is made, using 3 to 10 cc of quinine dihydrochloride. Ewell, Sargent and Marquardt,¹¹ from whose work we have quoted, report that one injection often suffices for a cure, in other cases several injections may be required.

These authors report that in one case, which had received three injections and was clinically cured, the cavity of the tunica vaginalis was opened one month after the last treatment. The sac was not obliterated but contained a small amount of dark amber fluid and several long loose strands of organized fibrin. Microscopic sections showed the subserous tissue of the tunica was thickened and infiltrated with organizing fibrous tissue. The authors believe this fibrosis prevents reaccumulation of the fluid.

The *advantages* of this method of treatment consist in the fact that it is accompanied by little pain, the patients are ambulatory and avoid hospitalization and there have been reported over 90 per cent of apparently permanent cures.

The *disadvantages* are the possibility of overlooking pathology in the scrotum, and the fact that certain cases are followed by transient epididymo-orchitis. The idiosyncrasy of many patients for quinine must be kept in mind. Temporary blindness has followed the administration of as little as 15 grains. The amount of quinine used in these cases varies from 4 to 12 grains.

OPEN OPERATIONS — Indications — One of the many variations of open operation may be performed in any type of hydrocele except in those cases in which the patient's preference or condition allows of palliative treatment only. Open operation is especially indicated, moreover, in those forms of hydrocele mentioned above in which the injection treatment is contraindicated or likely to fail. It gives the operator the additional advantage of examining the testis and epididymis for the presence of pathological changes, with the opportunity for appropriate treatment.

Technique — Local or general anesthesia may be used. After proper preparation of the parts a high incision, 3 or 4 inches in length, according to the size of the hydrocele, is made, beginning over the external abdominal ring and extending downward along the course of the cord. [The high incision here advised has the disadvantage of providing faulty drainage. An incision directly over the enlargement seems sounder. Brief drainage with a small piece of rubber from the dependent portion of the wound combined with a firm compression bandage will promote rapid convalescence — Editor.] The tunica vaginalis is exposed and the subsequent steps differ according to the type of operation to be done.

SIMPLE EVERSION (Andrews's "Bottle" Operation) — The tunica vaginalis is opened at its upper pole and the fluid evacuated. The testis is brought outside the scrotum and extruded through the opening in the sac, which is made only large enough to admit of the passage of

the testis through it. The sac is then turned inside out and left without suture, or one or more sutures may be passed through the cut edges of the sac, securing it behind the cord to prevent reinversion. The testis and everted sac are now returned to the scrotum and the wound closed without drainage. In this operation the convalescence is short and there is little danger of hemorrhage owing to the absence of much dissection. There is seldom any testicular pain and the everted sac soon shrinks. The disadvantages of the operation are that it is not successful in old thickened hydroceles and that recurrence is not uncommon.

EXCISION AND EVERSION (Hinkelmann's Operation) is the procedure accepted today as the best type. After dissecting free the parietal layer of the tunica the sac is trimmed off down to within $\frac{1}{2}$ inch of its visceral

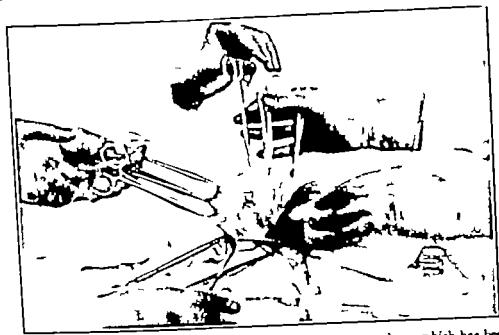


FIG. 261.—Hydrocele. The operator's hand rests on the unopened sac which has been dissected free down to the cord.

insertion and the two cut edges of the parietal stump are sewed behind the testis by a continuous catgut suture. Great care must be taken to secure firmly all bleeding points in the cut edges of the stump of the sac to prevent subsequent hemorrhage. The wound is closed with or without drainage as may seem best in the individual case and a support is applied over the dressing.

Bartlett¹ has described a method of total extirpation of the unopened hydrocele. It involves a rather unnecessarily tedious dissection, and is suited only to a restricted class of cases. Vautrin¹⁷ believes that in long-standing hydroceles with thickened walls, excision with eversion is not enough to prevent recurrence and he makes a new bed for the testis in the connective tissue of the scrotum. This he finds an absolute safeguard against relapse. Volkmann's operation of wide incision of the sac followed by swabbing its cavity with carbolic acid and allowing it

to become obliterated by granulation, has been abandoned on account of the slow convalescence and the likelihood of recurrence due to localized failure of obliteration. Von Bergmann's operation of simple excision of the sac has also been generally replaced by one of the methods given above.

Operative Complications — Operations for hydrocele may be followed by *hemorrhage*, *atrophy of the testis*, and *recurrence* of the disease.

Hemorrhage may take place as a result of the tearing of vessels during the separation of the sac wall or from the stump of the sac, and may develop some hours after operation, at which hemostasis was apparently complete. This can be guarded against at the time of operation by nice attention to separation of the sac along the proper line of cleavage, where one meets little bleeding, and by scrupu-

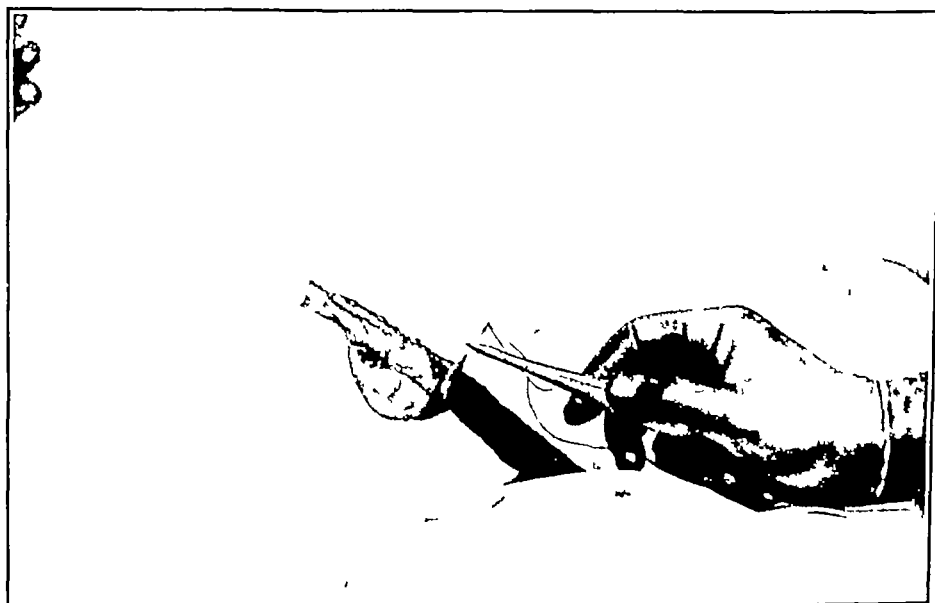


FIG 252 —Hydrocele. The sac has been excised to within $\frac{1}{2}$ inch of the testis. The first stitch is being taken in the everted edges, which are being sewed behind the cord.

lous care in tying off all bleeding-points. Porzelt³¹ advises tapping large hydroceles a day or two before the radical operation, in order to relieve tension and allow blood-vessels to regain their tone, thus reducing likelihood of postoperative hematoma. During the first twenty-four hours following operation, all cases should be frequently inspected for evidence of bleeding. If hemorrhage occurs there is early complaint on the part of the patient of pain and a sensation of tension in the scrotum. When the loss of blood is slight it may be left to be absorbed, when large the treatment becomes that of hematocele.

Atrophy of the Testis — Certain authors believe that the presence of the parietal layer of the tunica is necessary to integrity of the testis and that its removal in a radical cure for hydrocele interferes with testicular function. Others claim that the apparent atrophy of the testis which

has been reported after operations on hydroceles is due either to a pressure atrophy from the long-continued presence of the hydrocele or to some unusual operative complication which has damaged the testis. Rolando¹ extirpated the tunica in dogs and later removed the testis at varying intervals following the primary operation. He reported that the testes removed early were smaller and softer than normal and showed thickening of the albuginea with no evidence of spermatogenesis. Those removed two or three months later showed spermatogenesis, but not in normal amount. At all events this complication is rare and cannot be considered a contraindication to a radical cure of hydrocele.

Recurrence — The liability to recurrence after radical operation will be considered under the heading of Results.

Results of Various Types of Operation.—*Aspiration and Injection* — In former years iodine and carbolic acid were chiefly used as an injection medium. Statistics from various sources show that failure to cure resulted in from 6 to 11 per cent of cases. With the newer methods described above the percentage of apparent failures is much smaller although the patients have not been followed for a sufficient time to preclude later recurrences.

Open Operations — Of all types of open operations results were secured from 1216 cases with 30 relapses or 2.4 per cent. Of these there had been late investigation of 412 cases with 22 relapses or 5.3 per cent.

Choice of Method of Treatment.—*Tapping* has its place as a purely palliative measure in cases in which the patient's desire or condition makes it necessary and it occasionally may result in a cure in children.

Aspiration and injection may be expected to produce a definite number of cures in a selected class of cases. It possesses the advantage of ambulatory treatment, short convalescence and the avoidance of whatever slight danger attends any cutting operation. The excellent results which have followed the newer methods of injection treatment entitle it to serious consideration.

Open operations involve hospital confinement and a longer convalescence. They are adapted, however, to all types of hydrocele and are followed by few recurrences.

Hydroceles Due to Abnormalities of Development.

These forms of hydrocele are produced by interference with the obliteration of the peritoneal process in which the testis descends through the inguinal canal and require separate mention. The particular type of abnormality associated with each of these forms has already been described under Varieties of Hydrocele.

Congenital Hydrocele.—This form of hydrocele occurs in infancy and is generally idiopathic. Rare symptomatic cases have been reported with congenital lues and accompanying orchitis. The idiopathic type is due to muscular straining in crying or too tight binders causing pressure on the unclosed processus funicularis. Peiser²² reports

73 cases, of which 26 were double, 33 on the right side and 14 on the left. In the prone position the fluid can usually be pressed back into the abdomen.

Diagnosis.—Congenital hydrocele and hernia frequently coexist. Both extend through the inguinal canal and both give an impulse on coughing. When either condition exists alone they may be differentiated by the fact that hernia is resonant on percussion and gives a gurgling, jerky reduction, it is not translucent and the testis can be identified. Hydrocele is dull to percussion, gives an even, slow reduction, is translucent, and until after reduction the testis is lost in the hydrocele. When both conditions are present the signs may be confusing.

Prognosis—Many cases are cured spontaneously during the first year. Complication with hernia somewhat decreases the probability of spontaneous cure.

Treatment—Since hernia is a frequent complication, some authors⁹ prefer radical treatment between the third and six months to expectant treatment. If present the hernial sac may be treated at the same time. Injection treatment should never be used in this type.

Infantile Hydrocele—This is more common than the congenital form because the fluid does not communicate with the abdominal cavity; the hydrocele is always irreducible. Hernia is a frequent complication. "Hydrocele en bissac" is a rare type of infantile hydrocele in which a portion of the hydrocele is in the scrotum and a portion in the abdomen.

Treatment—Open operation, never injection, on account of the possibility of hernia coexisting.

Inguinal Hydrocele—This is a rare form of hydrocele surrounding an undescended testis. The treatment of the testis governs the treatment of the hydrocele.

Hydrocele of the Cord.—Hydroceles of the cord are of two varieties, *diffuse* and *encysted*.

Diffuse Type—The true diffuse form is a boggy infiltration of the connective tissue about the cord following the rupture of a hydrocele or spermatocele. Under the name of *multilocular hydrocele of the cord* are grouped echinococcus cysts, cysts of fetal remains and other rare types.

Symptoms—The diffuse and multilocular types present a boggy tumor of irregular outline, which may extend from the scrotum to the inguinal canal or higher. The mass may be somewhat translucent, with slight impulse on coughing, and partial reducibility.

Diagnosis—The tumor is to be diagnosed by its translucency and general irregular, boggy feel. In other respects it suggests an incarcerated omental hernia, and may occasionally be identified only after incision.

Treatment—Often no treatment is advisable, incision has been used.

Encysted Hydrocele of the Cord—This form represents a localized collection of fluid in the course of the cord. The fluid does not communicate with the tunica vaginalis below nor the peritoneum above.

Cysts may be large or small single or multiple. They occur more often in children than adults.

Treatment.—*Tapping* alone in children is often curative. *Aspiration* and *injection* with carbolic acid is useful in cases where the cyst is below the external ring. For cysts in the inguinal canal *excision* is indicated on account of the danger of hernia as a complication. Hematocele may follow injury to one of these hydroceles of the cord and demands the usual treatment of hematocele of the tunica vaginalis.

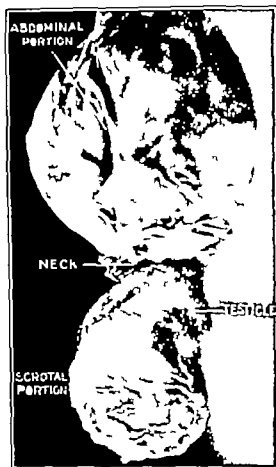


FIG. 253.*—Abdomino-scrotal hydrocele. Fluid content 3400 cc

Complicated Hydroceles—Complicated hydroceles are those which present two coexisting forms. In the past few years numerous reports have appeared in the literature of hydroceles of the cord communicating through a bottle-neck constriction at the external ring with a scrotal hydrocele. This type has been termed *abdomino-scrotal* or *inguino-scrotal* hydrocele. When a hydrocele of the inguinal portion of the cord outgrows the confines of the inguinal canal, it finds the least resistance in spreading posteriorly and dissects its way between the peritoneum and the internal surface of the transversalis muscle form.

Case of Dr. C. S. Roller, Calusa, California. Published by permission of the author and the Journal of the American Medical Association, 103: 671-672, 1934.

ing the abdominal portion of the hydrocele. This part of the hydrocele may reach a great size, forming a large tumor in the lower abdominal wall. Cases have been reported in which the mass displaced the bladder, and partially filled the pelvis.

Symptoms—In Roller's²⁵ case the abdominal portion was tense, not movable, apparently cystic, and painless. The scrotal portion presented the usual symptoms.

Differential Diagnosis.—Catheterization will rule out residual urine, a cystogram and a barium enema should exclude an intra-abdominal tumor.

Treatment—The treatment consists in removing both portions of the hydrocele and repairing the inguinal canal against a possible hernia.

Hydrocele of a Hernial Sac.—A collection of fluid in the sac of a hernia after its contents have been reduced and after either spontaneous or artificial obliteration of the neck of the sac. It must be differentiated from a recurrent hernia.

Treatment—Excision.

HEMATOCELE

An *hematocele* is formed when there is hemorrhage into the cavity of any form of hydrocele. Hemorrhage into the tissues is properly termed *hematoma*. As infiltrations of the scrotum and testis with blood often accompany the bleeding into the hydrocele sac, we frequently have the combination of hematocele and hematoma, to both of which, however, the former term is generally applied.

Etiology—Hematocele may be *traumatic* or *spontaneous* in origin. If *traumatic* (1) it follows blows or crushing injuries of the scrotum and its contents, in which case the hemorrhage may infiltrate the scrotum as well as the hydrocele sac, or (2) it may be the result of hemorrhage subsequent to any operation upon a hydrocele or upon the epididymis or testis. *Spontaneous* hemorrhage into a hydrocele sac may occur in conditions of arteriosclerosis and scorbutus.

Whitney⁶ reports a case of spontaneous rupture of a blood-vessel in the wall of a hydrocele in a case of syphilis.

Symptoms—*Traumatic* hematocele develops quickly with pain and tension in the scrotum and rapid increase of size of the hydrocele sac. Skin ecchymoses are frequently present. *Spontaneous* hematocele is of slow and insidious development, is almost never painful, and resembles the growth of a hydrocele. The contents of a recent hematocele are fresh blood, which later becomes brownish or chocolate-colored from admixture with fibrin and disintegration. The sac cavity may be entirely obliterated by fibrinous growths projecting from the sac wall and pressure on the testis in long-standing cases may cause its complete atrophy. Barrington¹ reports a case of spontaneous rupture in a hematocele of nine years' duration. Examination of the testis removed at operation showed that though it appeared normal macroscopically, there was entire degeneration of the tubules.

Diagnosis.—With a definite history of recent injury to or operation on the scrotal contents the diagnosis of hematocele is easy and is made by the same signs as those presented by acute hydrocele minus the translucency and with the usual added presence of ecchymoses. The real difficulty in diagnosis is to differentiate the slowly developing painless hematocele caused by spontaneous hemorrhage into the tunica vaginalis from a neoplasm of the testis. Woolfenden⁴ reports a supposed case of hematocele which was assigned to students by examiners for the degree of M. B. which at later operation proved to be a sarcoma of the testis.

Treatment.—Ordinary traumatic hematocele requires the same treatment as acute hydrocele—rest, elevation and hot moist dressings. Many authors recommend the application of ice and cooling lotions but they are not as grateful to patients in our experience at least as some form of heat. Extensive hemorrhage with danger of atrophy of the testis from pressure or suppuration demands incision and drainage. With the more slowly developing type of hematocele due to spontaneous hemorrhage unless the history is perfectly clear it is far safer to operate to prove or exclude the presence of a malignant growth of the testis. Orchiectomy is indicated in long-standing hematocele.

CHYLOCELE (GALACTOCELE)

This is a rare condition in which chyle is present in the tunica vaginalis. It is usually seen in the tropics and is due to the presence of the *Filaria sanguinis hominis* in the lymphatics of the cord causing engorgement and leakage of the chyle into the tunica vaginalis. It resembles hydrocele except that its contents are milky and the patient presents the symptoms of filariasis.

Treatment.—The treatment consists in *excision* with an attempt to remove the affected lymphatics.

SPERMATOCELE.

Etiology.—Spermatoceles are true retention cysts in or about the epididymis or rarely of the testis. Rolnick⁴ says "The Wolffian body in its degeneration after forming the head of the epididymis forms the aberrant vas of Haller at the tail and usually an aberrant tubule at the head. The exciting etiological factor is evidently secretory pressure into the blind tubule which gradually dilates its end to produce a cyst. That obstruction is no factor in etiology is well recognized in that occlusion of the epididymis in gonorrhea never produces a spermatocele. The same author believes that the larger cysts at the head of the epididymis are due to a vas efferens which ends blindly and does not continue to form one of the cornu vasculosa at the head of the epididymis.

Frequency.—Spermatoceles occur more frequently than is generally supposed probably in 1 per cent of all males (Rolnick). The reason

they are not recognized more often is that they are usually small and symptomless, and are not discovered if a careful examination of the scrotal contents is not made.

With relation to the tunica vaginalis these cysts may be *extravaginal* or *intravaginal*. The *extravaginal* type is the more common and usually arises behind the testis and between it and the epididymis, and develops in a direction in which there is no covering of tunica vaginalis. The *intravaginal* type develops from some portion of the epididymis, which is covered with tunica vaginalis, and pushes it ahead of it in its growth. These cysts may attain large size and entirely fill the cavity of the tunica vaginalis. Their rupture into the cavity is held to be a cause of hydrocele as well as to account for the presence of spermatozoa found in some hydroceles. Spermatocele occurs mostly between the ages of twenty and forty years, there are few cases in old men. It is more frequent on the right than on the left side and may be bilateral, it may accompany hydrocele.

One family is on record in which there are three sons, all of whom developed in the course of their young maturity, right-sided spermatocele.*

Pathology.—Spermatoceles conform to the type of true retention cysts in that they arise from a preformed cavity, they are lined with its epithelium, and their contents correspond to that of the affected organ. Injection preparations have been made from spermatoceles showing direct connection with seminiferous tubules. The larger cysts which usually occur in young adult life are attributed to obstructive processes in the vasa efferentia, and the smaller cysts of later life, to senile cystic enlargement of the tubules.

Fluid.—The fluid of spermatocele is opalescent and filled with seminal elements. Its amount rarely exceeds 3 or 4 ounces, although cases have been reported in which over 50 ounces were withdrawn. As distinguished from hydrocele fluid it is cloudy, neutral, of light specific gravity (1009), and contains less solids and albumin. Spermatocele fluid contains no acid-soluble phosphorus or glucose, these are added to the semen in the vesicle (Huggins and Johnson).⁴ The spermatozoa may be motile or dead. The former occurs if a connection exists between the cyst and seminiferous tubules, through which fresh semen is constantly supplied. If the spermatozoa are dead it is supposed that the connection with vasa efferentia has been lost.

Symptoms.—The cysts of young adult life present the signs of a slowly growing painless enlargement at the top of the testis. Pain at the end of intercourse has been reported in a few cases of the intravaginal type. Spermatoceles vary in size from a small marble to a mass larger than the testis. The tumor is usually heart-shaped, and if of large size may produce a sense of dragging on the cord. It is not translucent, may be fluctuant, and is elastic and tense. The position of the testis depends upon the direction of growth of the spermatocele, and may be pushed forward, downward, or backward.

* Personal communication.

Diagnosis.—The demonstration of a heart shaped tumor above and behind the testis and the recovery of the typical fluid by aspiration are the chief means of diagnosis. The shape of the tumor however is not constant nor its position with relation to the testis. The testis and epididymis can be more clearly palpated than in hydrocele when they are surrounded by it. If the spermatocele is complicated by hydrocele or if it is of the intravaginal type, the diagnosis will only be made by aspiration. Hydrocele of the cord cannot at times be differentiated from spermatocele. The former occurs chiefly in childhood however is distinctly separable from the testis and epididymis and fixed as a part of the vas. Larger spermatoceles have been mistaken for a third testicle very few authentic cases of which have ever been established.

Treatment.—Small cysts require no treatment. Aspiration and injection are usually ineffectual and not to be advised. Larger cysts should be excised. After incising the skin over the cyst it is opened, its contents evacuated, and the cyst wall shelled out. Often a well-defined pedicle is found which should be tied off. The wound is closed with or without drainage as seems best.

VARICOCELE

Varicocele is a condition in which there is dilatation elongation and tortuosity of the veins of the spermatic cord. It is generally limited to the spermatic vein, although occasionally the cremasteric and deferential veins may also be affected.

Anatomy.—The spermatic vein originates at the posterior border of the testis as a thick network of eight to ten vessels called the pampiniform plexus most of which lies anterior to the cord. These veins pass upward through the inguinal canal and unite into one trunk in the abdominal cavity. The vein of the right side passes into the vena cava the left vein into the left renal vein.

Symptomatic Varicocele.—*Varicocele may be symptomatic or idiopathic.* The *symptomatic* type is the result of obstruction to the spermatic vein by some abdominal tumor. It is rare occurs late in life develops rapidly and is associated with malignant growths especially of the left kidney though it may be produced on either side. White¹³ reports a case of acute left varicocele of six weeks duration which immediately disappeared on the removal of a pyonephrotic left kidney. The sudden appearance of a right-sided varicocele in an elderly patient would be especially suggestive.

Diagnosis.—The age of occurrence its rapid and painless development, and the fact that when the patient lies down the veins do not empty themselves as in ordinary varicocele are the principal points of diagnosis.

Treatment.—The varicocele disappears with the removal of its cause.

Idiopathic Varicocele.—**Etiology.**—This type is a common condition in young men between the ages of fifteen and thirty-five years. In a study of 403 cases Barney² found 81 per cent occurred between those

ages, and were unmarried. Youth and celibacy seem to be suggestive factors. The classical location is the left side (over 90 per cent), the right side is rarely affected alone, and both sides more rarely. Of 3911 cases, Curling² found 3360 on the left side, 282 on the right, and 269 bilateral. Sistach,² in 7611 cases, found 308 on the right and 305 bilateral. Ebner⁷ states that varicocele on the right side occurs in left-handed men.

Many causes have been adduced to account for varicocele. To say that the spermatic veins are long and tortuous, with a vertical course, and receive little or no support from the loose surrounding tissues, offers a seemingly reasonable explanation, but these factors are present in every male, and all men do not have varicocele. To account for the preponderance of left-sided varicoceles are the anatomical facts, that the left testis hangs lower than the right, the left spermatic vein is consequently longer, it has no valves, and empties at right angles into the left renal vein where it is less advantageously drained than on the right side, where the vein enters the vena cava at an acute angle and a lower level. Warwick¹⁷ states that in the normal body the entrance to the spermatic vein from the vena cava and the left renal vein is completely valved, and that in varicocele these valves are incompetent. Hence he believes the cause of varicocele is intra-abdominal pressure transmitted along the unvalved spermatic vein.

These facts are undoubtedly of importance, but they still do not explain the occurrence of varicocele in the young and its comparative absence in the old, in whom conditions would be supposedly ideal for its development. The most probable explanation is that varicocele is a functional disorder, due to a local chronic passive congestion induced by unrelieved sexual stimulation or by overindulgence. This hypothesis would account for the frequent disappearance of varicocele under the normal sex relations of married life and its absence in old men whose sexual powers are in abeyance. A congenital diathesis to varices, constipation and truma, claimed as contributing factors, probably have no relation to the production of varicocele.

Pathology —The veins may be merely tortuous and dilated, or the process may go on to the stage of complete breakdown of the valves with fatty atrophy, areas of thickening, and phlebolith formation.

Symptoms —Varicocele may produce no *subjective* symptoms even though of considerable size. Conversely a small developing varicocele may be the cause of a great deal of dragging *pain* along the course of the cord and in the testis. This is probably analogous to the pain in the leg at the time of development of a varix.

Mental symptoms varying from mild sexual neurasthenia to melancholia are often associated with this as with other genital diseases. The quack and the charlatan have found in varicocele a gold mine.

The *objective* symptoms are the low-hanging testis, the relaxed scrotum, and the mass of enlarged tortuous veins. The scrotal veins may at times be affected also. When the patient lies down the veins empty themselves and the varicocele disappears. Atrophy of the testis

follows a long interference with its circulation but is comparatively uncommon (11 per cent). Many cases of restoration of the testis to normal size and consistency after operation have been reported and certain authors believe that the apparent atrophy was merely under development.

Diagnosis.—The peculiar feel of the enlarged veins in varicocele is so characteristic that it is not likely to be confounded with any condition except an omental hernia. This may be differentiated as follows. If after the veins are emptied by having the patient lie down the finger is held over the external ring and the patient rises the varicocele if one is present refills, while an omental hernia is held back by the finger. The complicating presence of a hydrocele or hernia may make the diagnosis more difficult.

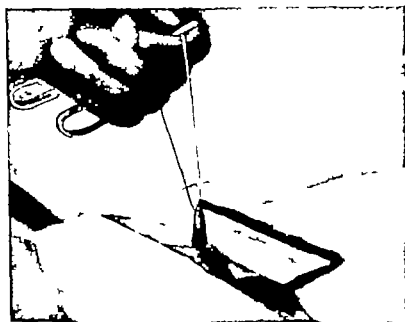


FIG. 254.—Varicocele. The veins have been separated from the cord and ligated above and below.

Treatment.—Many varicoceles require no treatment, as they produce no discomfort. The local symptoms produced by many others may be entirely relieved by the use of a snug suspensory. The patient should be strongly assured that his disease is not serious and that it will not lead to impotency or any other of the dire results of which these sufferers are apprehensive. Mental symptoms should be met by a rational psychotherapy with sex hygiene and marriage offered as a solution of the trouble.

Indications for Operation.—For the cases in which for various causes the foregoing measures do not suffice operative treatment is indicated. In Barney's series of 403 cases the patients came to operation for the following reasons: unrelieved and persistent pain 270; no special reason given 68; inconvenience 22; mental symptoms, 18; qualifica-

tions for civil, army or navy service, 17, recurrence following previous operation elsewhere, 8

In the Germany army¹⁹ a suspensory is first tried with officers and men complaining of symptoms from the varicoceles. If they are not relieved by this treatment operation is done.

Operation is indicated then in varicoceles for *persistent pain* unrelieved by a suspensory, for *uncomfortable size*, in cases in which *atrophy of the testis is feared*, and in the presence of marked *neurotic symptoms*. The operation in itself, however, will not cure sexual neuroses, and we have seen patients who were so disappointed at lack of immediate results that their last state was worse than the first. A course of psychotherapy following the operation is important with neurotic patients, and no operation should ever be done on them without the

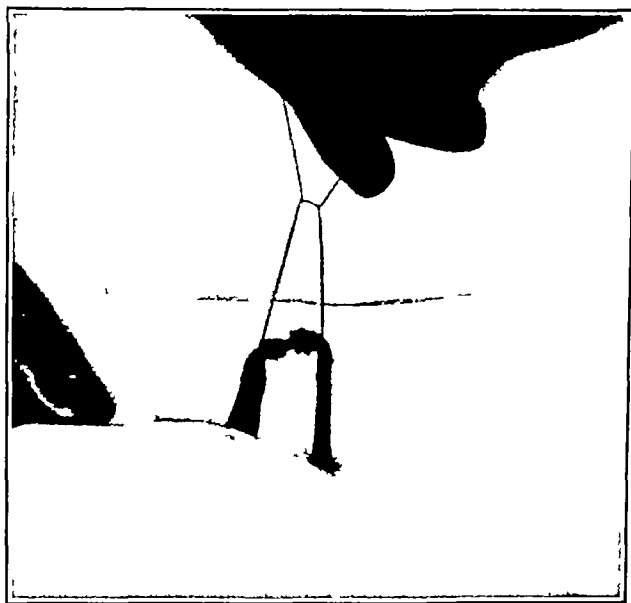


FIG 255 —Varicocele. A section of the veins has been excised, and the two stumps are being tied together.

existence of a definite pathological condition in the veins. Other indications for operation are the absence or disease of the other testis, the complication of hernia or hydrocele of the same side, a history of a recurrent phlebitis, thrombosis, spontaneous rupture, or calcareous condition of the veins.

Types of Operation —Varicocele may be treated by *injection* as in varicosities elsewhere in the body, by *subcutaneous ligation*, or by *open operation*, involving excision of a portion of the anterior group of veins with elevation and support of the testis. The writer has never employed the *injection* method.

Subcutaneous ligation of the veins of a varicocele is a blind and unsurgical procedure. It presents the danger of hemorrhage from the wounding of a vein with a needle and the possibility of recurrence from the failure of the ligature to obliterate the vein. It offers, further, no

support for the testis. The method should be abandoned in view of the simplicity and efficiency of the following operation

Open Operation.—Technique—Local or general anesthesia may be used preferably the latter if the patient is neurotic. A high incision 2 inches long is made above the inguinal canal with its lower end over the external ring. The dissection is carried down to the cord with its overlying veins and the fascia enclosing it opened. At this level the veins have united into three or four trunks and may easily be separated from the vas and its vessels. By pulling up the testis into the incision the separation may be carried down to within 1 inch of it. The separated mass of veins is ligated above and below and a sufficient section is excised so that by approximating the two stumps the testis will be elevated to a proper position opposite its mate. It is important to remove only the anterior group of veins. In this way interference with the blood supply of the testis and its subsequent atrophy will be avoided. [It is often true that the dilatation of the veins below the point of ligature and particularly those around the epididymis remain a cause of discomfort after this operation. Careful tying of these veins in continuity is advisable.—FRIEDOR.] Great care should be taken to secure firmly all the cut veins by individual ligatures if necessary. The distal stump of veins is then brought up to the proximal stump and tied to it which serves as a support for the testis. Fascia and skin are closed without drainage and a suspensory dressing applied. Patients should be kept in bed about a week.

Ablation of the scrotum with the idea of providing a support for the testis is a useless procedure, as the scrotal skin which remains is capable of further stretching. It is also unnecessary for the purpose of removing redundant tissue as this will slowly contract when the weight of the testis is removed by elevation.

Certain authors feel that joining the cut ends of the veins does not in itself produce a sufficient support for the testis and have advised various measures. Jacob⁸ elevates the testis by attaching the distal stumps of the excised veins to the fibers of the external ring. Allison¹ shortens the fascial covering of the veins, excising a cuff of fascia and bringing the edges together. Turner accomplishes this by sewing up a longitudinal slit in the fascia transversely.

Londres¹⁰ suspends the testis by a strip of fascia from the external oblique muscle folded down and attached to the testis. The pubic insertion of the fascia remains attached and the free end is fixed to the testis at a level just below the ischio-pubic bone.

Complications.—Atrophy of the testis and secondary hydrocele have been rare sequels to operative treatment of varicocele in the writer's personal experience. Other observers have recently reported an unusually high percentage of complications. (See under Results.)

The formation of the secondary hydrocele is thought by Douglas⁴ to be due to disturbance of circulation predisposed by the presence of a slight amount of infection in the thrombosed stumps of the excised veins which anastomose with the veins accompanying the vas deferens.

Hence the development of a hydrocele may be the unavoidable sequel of a properly performed operation for varicocele. These secondary hydroceles in some cases absorb spontaneously, others require tapping, certain others will need radical operation.

Hemorrhage from the slipping of ligatures on the stumps of the veins may be serious.

Results—In the series quoted above a certain number of the cases were investigated at periods of from one to ten years after operation. Of these, 36 per cent still complained of some pain in the groin or testis, 27 per cent had some form of sexual neurosis, and 15 per cent had recurrences. On the other hand, there was no case of atrophy of the testis, in 30 per cent the testis had grown larger since operation, and 80 per cent acknowledged they had been distinctly benefited.

Jacob,⁸ in a series of 237 cases operated upon in a French Military Hospital between 1909–1914, reports no serious postoperative complications, and no case of atrophy of the testis. He was able to observe these men during the year or two years of their military service, and a portion of them he examined still later, and found them well.

Allison¹ reports 300 operations for varicocele following which were 4 hydroceles requiring operation.

In the United States Army during the years 1914, 1915 and 1916, there were 1082 hospital admissions for varicocele, an average admission rate of 2.74 per 1000. Of these cases, 655 were operated upon, and the results were recorded as successful, although it is not certain how much opportunity there was to check end-results.* There are at present no statistics available at the Surgeon-General's Office as to results of operations for varicocele in army hospitals during the World War.

In sharp contrast to these favorable statistics, are reports of bad end-results following varicocele operations, which began to appear during and after the recent World War, incident to the large number of operations which were done on enlisted and drafted men. Bloodgood⁴ issued a warning against indiscriminate operating on varicoceles for the following reasons: (1) That most varicoceles disappear spontaneously by the age of thirty, (2) that neurasthenics with varicocele are rarely relieved of their nervous symptoms by operations, (3) that postoperative complications of hydrocele, which is more annoying to the patient than the original condition, and atrophy of the testis, are too frequent to be ignored.

He also adds that where a patient has both varicocele and hernia, excision of veins should never be done at the time of radical cure for hernia, as danger of atrophy of the testis and secondary hydrocele is much greater.

Douglas⁶ reports a series of 303 cases operated upon at St. Luke's Hospital, New York, between January 1, 1917, and April 1, 1920. Of these the end-results were checked in 116 cases. In 76 cases examined personally, 37 were well, 30 had secondary hydrocele, of which

* Personal communication from the Surgeon-General's Office.

22 were large 4 had atrophy of testis and 2 still had varicocele. Letters were received from 40 of whom 30 were well 7 had hydrocele and 3 had pain. Of the 116 cases 30 per cent had hydrocele and 4 per cent atrophy of testis. From these discouraging results Douglas concludes that operation for varicocele should not be performed except for well-marked cases with painful symptoms and in non neurasthenic subjects, certainly not in the type of cases previously referred by the various medical examining boards for admission to army and navy.*

He further says that in view of malpractice suits resulting from some cases in this series the surgeon should protect himself by explaining to the patient the possibility of postoperative hydrocele or atrophy of the testis. Every care should also be taken during operation to avoid trauma to the veins of the cord to prevent hematoma and infection and thus limit thrombosis.

The writer cannot believe that the bad results in this last series can be taken as a criterion of average results to be expected in civil life. It seems possible that in time of war poor selection of cases insufficient time for convalescence and the rigorous conditions of active service combined to produce these complications. These figures should impress upon the surgeon the definite possibility of postoperative complications and cause him to select his cases for operation with care.

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CHAPTER XIII

INFECTIONS OF THE TESTICLE

By J DELLINGER BARNEY, M D , F A C S

ACUTE infections of the testicle as compared with those of the epididymis are relatively infrequent, for, as Smith³² well says "It is only in recent years that differentiation has been made between processes affecting the epididymis and those affecting the testicle. Even today we frequently hear of 'gonorrheal orchitis' when epididymitis is the real disease."

But it must be borne in mind that infection of the testicle proper, although uncommon as compared with that of the epididymis, arises not infrequently as a complication of certain of the infectious diseases. These diseases are typhoid and paratyphoid fevers, smallpox, and mumps, tonsillitis, glanders, dengue, acute articular rheumatism, gout, scarlet fever, Mediterranean fever, pneumonia, diphtheria, influenza and typhus fever. Infections of the testicle are also reported during the course of malaria, and filariasis, and of course the effect of the *Spirochæta pallidum* on the testis is well known.

In the presence of a septic process anywhere in the body such as osteomyelitis, abscess of the testicle may occasionally arise, while a certain number of cases have been reported of infection by the colon bacillus, the *Bacillus mucosus capsulatus*, and the *Staphylococcus aureus* and *albus* whose source could not be determined.

Etymology.—An inquiry into the frequency with which the testicle is attacked in the various infections already enumerated shows that in proportion to the number of cases of the disease these testicular infections are rare.

Pike,²⁶ in 1911, collected from the literature 102 cases of orchitis of typhoid origin. McCrae²⁴ found only 4 in a series of 1500 cases (0.27 per cent), while in a total of 5500 cases of typhoid fever, the combined statistics of Osler,²⁵ Liebermeister,²³ Sorel,³³ and Holscher,¹⁴ the testicle was involved but 14 times (0.25 per cent). On the other hand, Pierre Do¹⁸ found no instance of epididymo-orchitis among 14,738 cases of typhoid fever collected from French and German sources.

The severity of the typhoid fever has no relation to the incidence of orchitis. It usually arises early in the course of convalescence, may attack a patient of any age (usually the young adult), and in most cases involves both testicle and epididymis. Beardsley,³ in 102 cases, found both sides involved in 3, when unilateral, the right side was affected more often than the left. Suppuration occurred in 22 of the 102 cases. In 13 suppurating testicles reported by Kinnicutt¹⁹ a pure culture of the typhoid bacillus was grown from the pus. Symptomatic hydrocele is not infrequent.

More recently Cade, Vaucher and Huchon⁴³ have studied infections of the testicle in typhoid and paratyphoid fevers. They report 5

cases of their own of which 2 were due to the typhoid bacillus and 3 to the paratyphoid bacillus. These infections were always unilateral. Suppuration occurred in 2 cases both paratyphoid infections.

Syphilis of the testicle (gumma) is said to be uncommon and will probably become more so owing to improved methods of treating the disease. Keves¹⁷ in 2170 syphilitics found the testicle involved only 67 times of which but 10 were bilateral. While I have no definite statistics of these cases, I believe them to be more numerous than this. The testicle alone is affected in a small majority; in others the epididymis shares the infection. Suppuration of the gummatous testicle is rare but necrosis may occur from endarteritis.

Acute orchitis as a complication of smallpox (variola) and due to secondary pyogenic infection has long been recognized but its incidence as given by different writers seems to vary widely. It seems to occur both before and after puberty. Thus Roger²⁰ found 48 infected testicles out of 55 in patients dying from smallpox while Quénu²¹ says that in severe forms of the disease the testicle is left intact only once in ten times. On the other hand Hare and Beardsley²² observe that orchitis single or double and usually accompanied by an effusion of fluid into the tunica vaginalis is a rare complication of variola. Welch and Schamberg²³ observed this complication but eight times in 2000 cases of variola. It is probable that the virulence of the epidemic, the method of treatment and the fact of vaccination are factors which would influence the incidence of this complication.

The orchitis of epidemic parotitis (mumps) is of frequent occurrence in the adult, and may occasionally occur before puberty. The well known study of Laveran and Catrin²⁴ shows that it is likely to occur once in every 3 cases of mumps. In 43 cases it was bilateral in 13 on the right side in 18 and on the left side in 12. Osler²⁵ records 211 instances in 699 cases of mumps. A recent exhaustive study of the literature of the testicular complications of mumps by Wesselhoëft²⁶ showed that orchitis occurred in 18 per cent of all cases with subsequent atrophy of the testicle in 55 per cent of the cases in which orchitis occurred. Wesselhoëft states that he nowhere found mention of an eunuch resulting from mumps a fact which would indicate the infrequency of orchitis before puberty. This author found only 2 cases of male sterility as a result of mumps suggesting that even in the case of a bilateral infection the spermatogenic power of at least one organ remains intact. The frequency of orchitis in a disease which is so common and otherwise so comparatively mild and the possible destruction of the spermatogenic function of the organ warrants serious consideration.

Such a complication in tonsillitis was long ago recognized by Verneuil²⁷ and later carefully discussed by Laségue.²⁸ Joal¹⁸ in 1880 reported 4 cases and went with great thoroughness into the relationship between tonsillitis and epididymo-orchitis. Occasional instances of this rare complication of tonsillitis are reported from time to time by Prouty²⁹ in 1912 and more recently by Benjamin and Quirk.³⁰ These authors describe a case of bilateral orchitis complicating an

unusually virulent follicular tonsillitis and subsiding rapidly after tonsillectomy

Vecchia⁴⁹ reports a case of orchitis arising during a very severe attack of malaria in a boy aged sixteen years. There was a history of previous attacks and the malarial parasite (type not stated) was found in the blood. Under the influence of quinine the orchitis and febrile attacks subsided.

According to Lombard and Béguet¹⁶ orchitis complicates Mediterranean fever in 5 or 6 per cent. This complication was apparently first described by Duffey,¹⁴ in 1872, who reported 18 cases, while Lombard and Béguet report a personal case and mention 21 others in the literature.

While he does not state the frequency of orchitis in pneumonia Mills⁴⁷ has recently reported a study of 60 testes removed postmortem from pneumonia patients. It would appear, therefore, that testicular infections in this disease are not a rarity.

Blechner and Stiassnie⁴⁰ have reported a case of bilateral orchitis and epididymitis in a boy, aged seven years, arising during the course of a very severe diphtheria. While they did not demonstrate the *B. diphtheriae* in this case they believe that this organism was responsible for the conditions noted.

An intensive study of typhus fever by Wolbach, Todd and Palfrey⁵¹ showed testicular lesions in the 16 cases studied histologically, but apparently there were few or no clinical manifestations.

Howard⁴⁵ states that "acute filarial orchitis and funiculitis is a common complaint" (in Zanzibar). Of 14 cases seen by him 7 resulted in abscess formation. These patients were all very ill but recovered promptly after the pus was evacuated.

Septic foci, such as furunculosis and osteomyelitis may occasionally give rise to an acute epididymo-orchitis, a case of the former being reported by Quénu,²⁹ while Biland⁵ records a similar complication in osteomyelitis of the acromion process. The rarity of an orchitis from this source may be judged from the fact that I have found no other cases of it in the literature.

Finally, there are on record a very few cases of what may be called "idiopathic" orchitis with infection by a pyogenic organism in the absence of any demonstrable focus. Du Bois⁸ reports such a case of staphylococcus infection, and Le Fui²² tells us of another. I have already reported 3 such cases and more recently have operated upon a fourth. My colleague, Smith, has also met with 1 within the year, at the Massachusetts General Hospital. In 2 of my own cases the colon bacillus was found in pure culture. In another the *Bacillus mucosus capsulatus* was the offender, with a few streptococci sprinkled in. Culture from the other cases were unsatisfactory.

Bonner,⁴² in 1913, reported a case of suppuration of the testicle following heavy muscular effort, no other causative factor being found. *B. coli* was found in the pus. More recently Nash⁴⁸ has reported 2 similar testicular abscesses, both occurring without definite etiology.

and one containing *B. pseudo-asiatricus* of Castellani the other showing *B. coli* and *B. proteus*.

Acute orchitis is mentioned in the text books as an occasional complication of glanders, influenza, dengue, acute articular rheumatism and scarlet fever. I have however seen no record of a definite case. While it is generally recognized that infection of the testicle by the gonococcus does not occur, two German investigators (cited by Fleischman²² names not given) have reported cases of definite abscess of the testicle in which gonococci were unquestionably demonstrated. One cannot help wondering whether these gentlemen made a sharp differentiation between the testicle and the epididymis.

It is therefore clear that almost any organism in the blood stream may enter the testicle and may under favorable conditions for growth, produce its characteristic lesions.

Pathology and Pathogenesis—It is well known that the animal organism combats bacillæmia by elimination of the bacteria in the circulating blood through the glands chiefly kidneys but we also know that the salivary glands (Quénu²³) the seminal vesicles (Huet¹⁴) and other organs may share in this work. That the human testicle may also assume this excretory function has been shown by Belfield⁴ who says:

While the kidney is provided with a new and private sewer the urter the testis continues to use the frog's old urinary duct now called epididymis and vas deferens. This excretory function of the testicle and its duct illumines both its intimate alliance with the kidney and its frequent infection from the blood. The recognition of the testicle as an excretory organ illumines the frequent invasion of its tubules by mumps, typhoid and colon bacilli, *Spirochaeta pallida* and other blood infections. Be it further noted that the testicle and other organs may assume this excretory role without damage to their epithelium (von Biede and Kraus²⁴) and when pathological changes occur they must be regarded as an index either of an unusual virulence of the organisms or of a lowered resistance on the part of the gland.

While we have already seen that the testicular tissue is favorable for the growth of the typhoid bacillus, the *Spirochaeta pallida* and pyogenic bacteria as well as for certain other as yet unknown organisms (e. g. that of mumps) it is common knowledge that the gonococcus rarely if ever finds lodgment in this organ and the tubercle bacillus (with very rare exceptions) only after a primary invasion of the epididymis. For an explanation of this phenomenon we must ascribe to the testicle an excretory function to the various bacteria a tendency to select one tissue rather than another in which to take up their residence. It is well established that organisms of various types may and do circulate in the blood stream at various times. It is clear that these organisms must find their way into the testis and epididymis as freely and as frequently as into other organs perhaps more so owing to their common blood supply the spermatic arteries which take origin from the aorta. This has been demonstrated by Piqué and Worms²⁵ in a large series of careful dissections of injected human specimens (Figs. 256, 257 and



FIG 256—Type I 1, spermatic artery, 2, epididymal branch of the spermatic, 3, deferential artery, 4, funicular artery, 5, epididymo-funiculo-deferential anastomosis in form of T (From Picqué and Worms, loc cit)

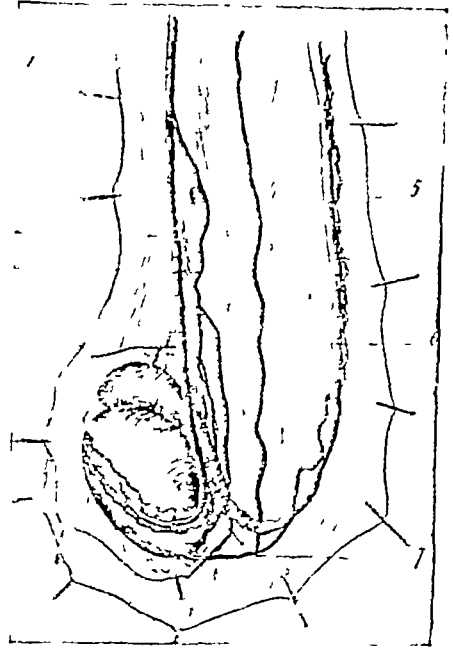


FIG 257—Type II 1, spermatic artery (main trunk), 2, internal spermatic artery, 3, external spermatic artery, 4, epididymal branch, 5, deferential artery, 7, spermato-funiculo-deferential anastomosis in form of T



FIG 258—Type III 1, spermatic artery, 2, epididymal branch of spermatic artery, 3, deferential artery, 4, funicular artery, 5, anastomosis between epididymal branch and deferential artery, 6, anastomosis between a testicular branch of spermatic and funicular artery

258) They have shown constant but slightly variable anastomoses between the spermatic the deferential and the funicular arteries (the latter running in the walls of the tunica vaginalis) It is thus seen that bacteria reach the testicle and epididymis with equal facility While the comparative infrequency of orchitis as compared with epididymitis is undoubtedly due very largely to the fact that the testicle as Belfield⁴ has shown excretes the bacteria which enter it into the epididymis there are two other factors which undoubtedly contribute to its comparative immunity from infection These are

First, the tunica albuginea whose protective value was long ago recognized by Grunin¹² He says When the contiguous organ or adjacent part is of a different structure from that of the cellular tissue the extension of the inflammation inward is checked Thus in the case of the inflamed tunica vaginalis the cellular tissue readily transmits the morbid action to the epididymis but the tunical albuginea arrests its progress to the body of the testicle

Second, Testut¹⁴ and others have pointed out that the testicle is surrounded and permeated by a very rich lymphatic network, much greater than that enjoyed by the epididymis

Furthermore the elaborate blood supply, already mentioned while serving as a path along which bacteria can travel undoubtedly serves at the same time as a highly efficient means of defense

In most testicular infections it is obvious that the organisms travel by way of the blood stream This would hold true in general systemic diseases such as typhoid fever, or in pyogenic septicemia (from furunculosis or osteomyelitis for example) In certain other cases the vas deferens or the lymphatics of the spermatic cord must be held accountable for the transmission of organisms

This hypothesis would apply particularly to the cases with preëxisting inflammation of the organs at the bladder neck or of the urethra as in a case recorded by Dalous⁷ and in 2 of my own cases The researches of many especially Baumgarten³ have shown that infections travel usually with the stream of the secretion of the organ involved While there are exceptions to this rule with reversal of peristalsis in the vas deferens, it is evident that it furnishes, in most cases ample ground for the elimination of this structure as a path along which organisms can travel

There is left then the possibility of a lymphangitis or of a phlebitis. While a retrograde lymphangitis is certainly an uncommon phenomenon Dalous⁷ and Quénu¹³ are in agreement that it can occur especially in the spermatic cord and testicle and they further observe that it may take place without the usual clinical manifestations of its presence Whether a phlebitis transmitting its infection to the testicle can be held accountable for these infections is open to argument. There appears to be no definite proof that it occurs The fact remains that in gonorrheal epididymitis it is not unusual to observe pain tenderness and induration of the spermatic cord slowly progressing from groin to epididymis and Kinnicutt¹⁵ describes a similar order of events in a case of typhoidal epididymo-orchitis

On the other hand, there are several examples of transmission of the infection from testicle to bladder and urethra, probably through the vas deferens. Thus in one of my cases the urine at first was clear and sterile to culture. Several days after orchidectomy there appeared a urethral discharge together with cloudy urine. Cultures showed the same organism as was found in the testicular abscess. This experience coincides with that of other observers. These data furnish additional proof of the excretory function of the testicle, which, by eliminating organisms through epididymis and vas deferens, infected the urethra and bladder neck.

Pathology.—The pathology of testicular infections has been comparatively little studied. Smith³¹ in a recent article describes a case of epididymo-orchitis of typhoid fever operated upon by Cabot. The former says: "There was a small amount of free fluid within the tunica and a gelatinous exudate covered the testicle. The epididymis was enlarged to four or five times its normal girth, was tense and hard, and in color a reddish purple. The testicle was of normal size, and in its upper two-thirds of normal color. The lowest third, which was separated from the upper portion by a sharp line of demarcation, was slightly swollen and of a darker color. A nick was made through the tunica albuginea of this part of the testicle, the underlying tissue was dry and did not bleed. No pus was obtained (from the epididymis) but the serous fluid which oozed from the punctures showed a pure culture of the typhoid bacillus. The involvement of the testicle was caused by the occlusion of its arterial supply (the capsular artery, a branch of the spermatic, which pierces the tunica albuginea close to the epididymis)."

There seems to be no good description of such infections of the testicle which have supplicated, but Gnide¹⁰ has shown that the suppuration is between, not within, the canaliculi.

The pathology of syphilitic infection of the testicle and epididymis is that of gumma, plus the changes wrought by interstitial sclerosis in the seminiferous tubules. These are destroyed to a greater or less extent by the sclerotic changes, but after an arrest of the syphilitic process show a marked recuperative power.

For the pathology of the orchitis of mumps we are again indebted to Smith,³¹ who recently operated upon two such testicles. The tunica vaginalis was opened "with escape of about 1 ounce of turbid yellow fluid. The testicle was three times the size of a normal testicle, firm and elastic on palpation. The color was more bluish than is usual, and throughout the tunica albuginea were scattered many minute reddish specks, probably punctate hemorrhages. The epididymis was definitely enlarged, soft, without induration, and of a deep red color which at the globus major became almost black. The cord was somewhat edematous, the vas normal." A second case presented "an almost identical picture." Small sections of these testicles were examined by Dr. S. B. Wolbach, now Shattuck Professor of Pathological Anatomy in the Harvard Medical School. He says: "The process does not affect the testicle tissue uniformly. There are groups of seminiferous (convoluted) tubules which are completely destroyed and distended

with exudate separated by areas of normal and slightly affected tubules which contain large number of mitotic sexual cells though few mature spermatozoa

The exudate in the destroyed tubules consists chiefly of polymorphonuclear leukocytes and phagocytic endothelial leukocytes. The cells of the tubules have mostly undergone a hyaline degeneration and are taken up by phagocytic endothelial leukocytes though there are occasionally perfectly preserved mitotic sexual cells scattered among the tightly packed exudative cells

The intertubular connective tissue everywhere is edematous and between the tubules most affected contains coarse meshed fibrin small areas of hemorrhage and many polymorphonuclear leukocytes and endothelial leukocytes

Among the groups of least affected tubules there are some with normal epithelium but with lumina partly filled with polymorphonuclear and endothelial leukocytes as if the process was spreading along the lumina

There are many more tubules however which show lesions involving a small portion of the circumference where it appears as if the process was extending from the intertubular connective tissue. In these places numerous leukocytes are found in the act of migrating through the basement membrane of the tubules. These small lesions contain deeply staining hyaline degenerated sexual cells hyaline fragments polymorphonuclear leukocytes and endothelial leukocytes. The immediately adjacent epithelium is usually full of mitotic sexual cells showing the various stages of spermatogenesis

The tunica albuginea is edematous and there are small hemorrhages and zones of cellular exudate about blood vessels. The cells about blood vessels are polymorphonuclear leukocytes and endothelial leukocytes.

Mitotic endothelial cells in the lumina of capillaries occur in the tunica albuginea and intertubular connective tissue

Liquefaction necrosis is not present either in the tubules or in the connective structures

No bacteria or other parasites can be found in the sections and in film preparations made at the time of operation

In both cases the blood cultures and the cultures from the hydrocele fluid and testicular tissue were bacteriologically negative

Thanks to Councilman²⁴ we have an admirable description of the pathology of the testicle in smallpox which I quote at length

Lesions most difficult of interpretation are those of the testicle. There is absence of spermatogenesis in the cases in which convalescence is established. Normal spermatozoa are absent in the lumina of the tubules and there is degeneration of the spermatogenetic cells. This affects both cytoplasm and nuclei and the degenerating nucleus assumes forms which present some similarity to certain of the intracellular parasites in the epithelial cells of the skin. This degeneration is not peculiar to smallpox but may be found in typhoid fever. These lesions are absent in the undeveloped testes of children

"In addition to diffuse degenerative lesions there are focal lesions as characteristic of the disease as the skin lesions found in adult and child's testes. Lesions begin as an infiltration of the intertubular tissue with both ordinary lymphoid cells and large mononuclear basophilic cells. The tubules in the foci are unaltered. From such lesions as these, which are best compared with small interstitial foci in the kidneys, the process extends. The area enlarges, the cellular infiltration extends and finally there is complete necrosis in the center, with fibrin and hemorrhage in the surrounding interstitial tissue. The necrotic tubules often contain numbers of phagocytic cells. The blood-vessels in the foci are obliterated in some cases by thrombi, but chiefly by the pressure of the cells. Acute endarteritis with accumulations of mononuclear cells is often found.

"The lesions vary in number, some testicles showing large numbers of them while in others they are found only after prolonged search. The smallest lesions and those best adapted for study are in the undeveloped testes of children. They show a general relation to the duration of the disease, the most advanced cases occurring late in the course.

"Notwithstanding its apparently specific nature no parasites were found in the testicular lesions of man."

Secondary infection of the smallpox testicle, at least in the suppurative cases is exceedingly common, for Esmonet,⁹ in a number of such cases, found streptococci, pneumococci, colon bacilli, and the *Staphylococcus aureus* alone or associated with the streptococcus.

The pathology of suppuration of the testicle, when due to pyogenic infection, is not peculiar, but it is fair to say that there is little available material on which to base an opinion. In a case operated upon by me, with infection by the *Bacillus mucosus capsulatus* and the streptococcus, practically the whole testicle was occupied by an abscess cavity (Fig 259). Sections of this testicle, examined for me by Prof. S. B. Wolbach, showed that necrosis had "extended irregularly into the substance of the testicle, following the interstitial tissue." In a second personal case, of colon bacillus origin, the abscess was found to occupy only the upper third of the organ, there being a fairly sharp line of demarcation between this and the rest of the testicle which was but little affected. In still a third case, only the lower third of the testicle was involved in the abscess. The normal-looking upper two-thirds of the organ was left behind, but became necrotic and sloughed out later. In a fourth orchidectomy (a recent case, unreported) I found a comparatively early stage of the infection. The whole testicle was riddled with abscesses of varying size, with tufts of seminiferous tubules sticking out here and there through holes in the tunica albuginea (Fig 260). A testicle very similar to this, with *Staphylococcus aureus* infection, has been described by Dalous.⁷

The recent light thrown upon the testicle in typhus fever by studies of Wolbach, Todd and Palfrey⁵¹ are interesting. These authors say

"Vascular lesions (thrombosis) are present in the testis or epididymis or both in all of the 16 male cases studied histologically. Perivascular

accumulations like those of the skin of a proliferative nature are present in most of these cases. In 5 cases *Rickettsia* can be satisfactorily demonstrated in the blood vessel lesions of the testis or epididymis.

In 7 cases there was a considerable degree of azospermatogenesis evidenced by absence of spermatozoa and diminution in the number or complete absence of mitoses. In 2 cases the aspermatogenesis is

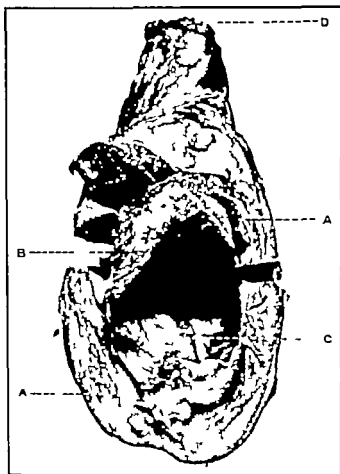


FIG. 259.—Abscess of testicle. Mucous capsulatus. Author's case. 4 thickened tunica. B remains of wall of testicle. C abscess cavity in testicle. D epididymis. Anterior view.

complete in some portions of the slides and is attended by slight hyaline thickening of the basement membrane of the tubules. These 2 cases were not attended by severe vascular lesions. One was attended by severe bronchopneumonia. We regard this change in the testes to be independent of local lesions and to a general effect of the disease. Similar aspermatogenesis has been observed by one of us in epidemic influenza and by Mills in epidemic pneumonias caused by the streptococcus and pneumococcus.

The lesion in the guinea pig's testicle produced experimentally by these authors are comparable in most respects to those found in man.

Thanks to Mills⁴⁷ we have been presented with a very minute picture of the testicle in primary pneumonia and in that which is

secondary to measles or influenza. Sixty testes were studied histologically. The pathological process seems to be a continuous one which Mills divides into six stages. He says that the edema may represent acute injury in another form and round cell infiltration suggests that possibly other factors than toxins may have a part. In the absence of definite evidence to the contrary the cause of the lesions is assumed to be due to circulating toxins. This observation is of interest in the consideration of the testicular lesions of mumps, smallpox, diphtheria, malaria, filariasis and other conditions where the organism is either not demonstrable or unknown. Mills further states that the *Streptococcus hemolyticus* produced more extensive change, while measles and epidemic influenza had little apparent

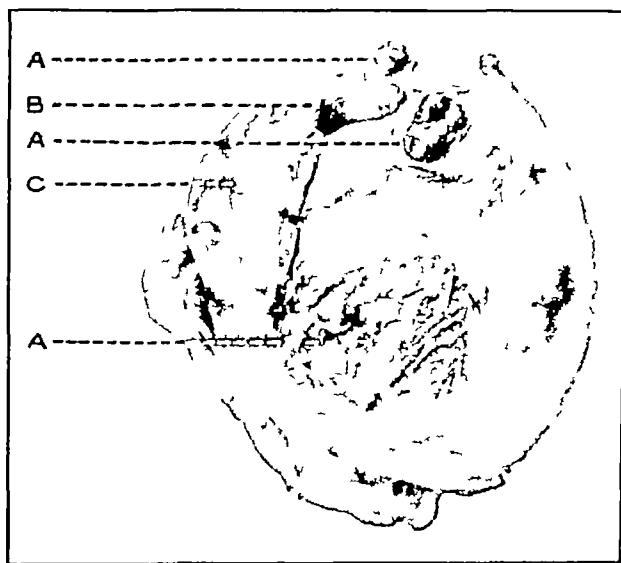


FIG 260 — Abscess of testicle. No culture. Author's case. A, A, A, tufts of seminiferous tubules protruding through tunica albuginea, B, hydatid of Morgagni, C, epididymis. Lateral view.

effect. The testicular changes in pneumonia are without apparent clinical manifestations, are non-specific, focal in character, independent of the infecting organisms or of the antecedent disease.

I have been unable to find descriptions of the orchitis which is said to occur in influenza, glanders and other infectious diseases, but it seems unlikely that their pathology offers any peculiarities.

From the foregoing consideration of the etiological factors, of the probable paths of infection, and of the pathology it is possible to state that acute orchitis can occur under three different conditions:

- 1 As a localization of a primary infection (mumps, typhoid, syphilis, pyogenic septicemia, etc.)

- 2 As a localization of a secondary infection is one of the above conditions.

- 3 As a propagation of a urethritis primary or secondary to a pyogenic infection of the prostate, urethra, or bladder neck.

It must not be forgotten, however, that a severe orchitis may be the

result not of actual bacterial invasion of the organ but of a bacterial toxemia. The studies of Mills quoted above would seem to bear out this view. The possibility of this has been demonstrated by E. monet* who produced total necrosis of the testicle (in dogs) by the injection of 10 drops of typhoid toxin. Also in 13 suppurating testicles of typhoidal origin Kinnicutt¹¹ found a sterile culture in 6. Smith¹² reported similar findings in mumps and Councilman* in smallpox.

Symptomatology and Diagnosis.—These two aspects of acute epididymo-orchitis can be considered together.

In syphilis of the testicle the onset is gradual and generally symptomless, the patient seeking advice largely because of the enlargement of the scrotum. The unilateral wood-like hardness involving chiefly the testicle, the complete absence of normal testicular sensation (an important point) and lack of tenderness, the irregular contour should suggest gumma at once. These findings together with a positive Wassermann reaction in the blood or cerebrospinal fluid or other evidences of syphilis should make the diagnosis clear. The diagnosis is established occasionally only by exploratory incision.

The symptoms of practically every other form of orchitis are those of acute inflammation localized to this organ or at least to the scrotum. The onset may be sudden and the pain intense, concentrating in the testicle or possibly radiating to the groin, back or perineum. In certain cases there is marked constitutional disturbance aside from that occasioned by the general infection from which the patient suffers. The temperature may be considerably elevated (102° to 103° F.) and nausea and vomiting may accompany the attack. In certain cases an accumulation of hydrocele fluid may make the differentiation between orchitis and epididymitis obscure; in others palpation will show a much enlarged tender testicle smooth and firm with an epididymis more or less involved. In the later stages the skin of the much enlarged scrotum may be red, edematous or in a state of phlegmon with distinct fluctuation concentrated especially on its anterior surface. The whole spermatic cord may be traced into the groin as a much enlarged conglomeration of vas vessels and cremaster muscle indurated and tender to the touch. The prostate and vesicles may or may not be inflamed and urethritis (in which organisms other than the gonococcus may be demonstrated) may exist. The urine may be clear and sterile to culture. It may on the other hand contain pus together with the organisms of either of the general infection (typhoid for example) or of the scrotal infection (as in a case of infection with *Staphylococcus aureus* reported by Quénu¹³). Accompanying these phenomena there may be the symptoms of bladder irritability.

A diagnosis of the cause of infection will depend upon circumstances. In the presence of parotitis (which incidentally may be easily overlooked) in the event of smallpox, typhoid fever or any other definite general infection the nature of the orchitis will be clear. One also would have suspicion aroused if the orchitis arose in the course of tonsillitis or of some localized pyogenic infection.

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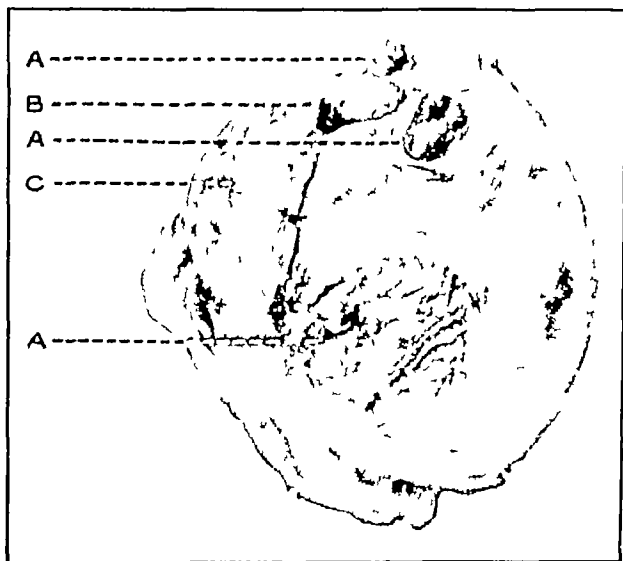


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bright for we have the word of Gosselin¹¹ that spermatozoa have been found in the semen after such treatment. Also in the words of Keyes¹²

Whatever part of the parenchyma has not been destroyed by sclerosis will continue to functionate and the testicle which has been syphilitic for years may still secrete spermatozoa. Secondary infection is not to be expected.

There seem to be no actual figures at hand as to the frequency of suppuration in the orchitis of smallpox but if we are to believe Lesmonet¹³ secondary infection is not uncommon. We are also left in the dark as to the probability of bilateral infection. The minute pathological picture of these testicles painted for us by Councilman¹⁴ and the apparent frequency of suppurative processes make the prognosis of such an orchitis bad from every point of view.

Pyogenic infection of the testicle primary or secondary apart from the diseases already enumerated seems never to be bilateral. Destruction of the gland is generally so complete as to require its removal. Even successful attempts at conservation will leave behind only a small mass of scar tissue.

Treatment.—The physician must be guided in his treatment of the case by local and general conditions.

In typhoid fever and mumps early and thorough drainage of the tunical sac by incision and of the epididymis and testicle by multiple puncture may be considered and in certain cases may be necessary. Palliative treatment will probably suffice for most cases and in the absence of actual suppuration the results may be as good as with drainage.

In the far-advanced cases with free pus and much tissue destruction orchidectomy is indicated.

The recent studies of orchitis in mumps by Bonnamour and Bardin¹⁵ throw some light on the possible prophylaxis of this complication. Sixty-five patients admitted to their service with mumps but without orchitis were given an injection of 20 cc. of diphtheria antitoxin. Among these patients only 5 per cent developed orchitis and this was mild. Another group of 7 patients were similarly treated and none developed orchitis. These investigators think that the results are suggestive that the prophylactic injection of antitoxin may ward off or attenuate complications in a disease of which we do not know the cause such as mumps.

Ballenger and Elder¹⁶ have recently pointed out the danger to the testicle in mumps and describe a technique (longitudinal incisions through the tunica albuginea) for preventing atrophy. Three testes so operated upon by them are now normal 2 after three years 1 after twenty months.

In syphilis, arsphenamine or neoarsphenamine and mercury will produce good often brilliant results. The knife is indicated but rarely.

In certain mild infections of the testicle the time-honored measures of rest in bed, an ice-bag and support of the scrotum by a suspensory or an Alexander bandage may suffice.

On the other hand, one must not forget that orchitis may appear spontaneously in a previously healthy individual, as in the case of Du Bois⁸ and of Le Fur²² and in those reported by the writer¹

Some difficulty might be encountered at the onset in differentiating between a torsion of the testicle and an orchitis. What begins as a torsion may rarely become an orchitis, owing to the interference with the circulation of the testicle and its subsequent invasion by bacteria. Exploratory incision or the gradual decrease of symptoms under palliative treatment, with atrophy of the testicle, will generally differentiate the two conditions.

Prognosis—The prognosis in acute orchitis may be divided into that for the patient, and that for the testicle involved, with a possible subdivision which takes the other half of the scrotum into consideration.

The outlook for the patient himself depends upon the nature of his infection. In typhoid fever, mumps, smallpox, syphilis or any other general infection, the mortality seems to be not at all influenced by the intervention of an orchitis. I have also seen no account of a death following orchitis when due to pyogenic organisms, whether primary or secondary.

The changes of saving the testicle vary also with the kind of infection, and must be considered from the stand-point of spermatogenesis, as well as from that of internal secretion. If extensive suppuration has taken place orchiectomy will be necessary. In certain cases evacuation of the pus by trocar or simple incision may suffice. It is to be expected, however, that the remaining portions of the testicle will eventually become so atrophied as to be of little or no value to the patient except possibly from a psychic stand-point.

In typhoid fever the combined statistics of Kinnicutt¹⁸ and of Hare and Beardsley¹³ show an incidence of suppuration of 22.5 per cent. The percentage of bilateral orchitis is very small (Kinnicutt 0.42 per cent, and Hare and Beardsley 0.44 per cent). When suppuration does not occur, atrophy, more or less complete, is to be expected, with a consequent destruction of the functional activities, especially spermatogenesis, of the organ. Smith³¹ has recently shown us that this is due to a destruction of the arterial supply of one or another portion of the testicle. His case also suggests the desirability of drainage at an early stage of the infection.

In mumps we have seen that orchitis occurs once in about every 3 cases. Laveran and Catrin²¹ show a bilaterality of 30 per cent, and a subsequent atrophy of 60 per cent of the testicles so affected. Secondary infection does not seem to be mentioned. Smith's recent work³² in this affection suggests that the subsequent atrophy, which completely destroys the sexual function of the gland, may be obviated or lessened by early operation. It has been shown that the testicle is attacked by the *Spirochæta pallida* rather infrequently (67 times in 2170 cases, Keyes¹⁷), and both sides are affected in 6.7 per cent. With proper antisyphilitic treatment the future of the testicle seems to be

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CHAPTER XIV

GENITAL TUBERCULOSIS.

By J. DELLINGER BARNEY, M.D., F.A.C.S.

THE term genital tuberculosis in its strictest sense refers to an invasion of the male genital organs, *i.e.* epididymes testes, scrotum vasa deferentia seminal vesicles and prostate. Unfortunately the less accurate term genito-urinary tuberculosis is used by many when they refer to purely genital tuberculosis. Nor is the term always incorrect for it is well known that the urinary tract *i.e.* kidneys ureters, and bladder is often involved simultaneously with the genital tract. Which of the two tracts was primarily attacked does not concern us here nor is it always possible to determine this point.

I wish to stress at once, however that this chapter deals primarily with tuberculosis of the male genital organs tuberculosis of the urinary tract will be dealt with only as it is found to be coincidental with the genital tuberculosis.

Incidence of Tuberculosis.—The statistics of the world show tuberculosis to be one of the most common and fatal of all diseases. Cornet²⁸ says that in 1894 in Germany the death rate from tuberculosis was 21 per 10 000 while in 1908 the number fell to 16.24. From 1896 to 1900 108 664 died of tuberculosis of the lungs while in 10 000 this disease was found in other organs.

That the fight against tuberculosis is proving successful is obvious from the figures now at hand. In the registration areas of the United States the death-rate for 1933 for all forms of tuberculosis was 38.5 per 100 000 of population. In Massachusetts for 1934 the death rate from lung tuberculosis alone was 43.8 per 100 000 and for other forms of tuberculosis 4.9 per 100 000.

The figures for Boston Massachusetts for 1933 show a mortality of 60.7 per 100 000 for pulmonary tuberculosis and 7.4 per 100 000 for other forms of this disease. Unfortunately there seem to be no available national state or municipal statistics which give satisfactory details of the distribution of the disease among the different organs. Also it may be said in the light of our present knowledge of tuberculosis that these figures must necessarily be somewhat unreliable. If a patient is reported as dying from renal tuberculosis for example who can say unless an autopsy was done that lung tuberculosis did not exist?

Incidence of Genito-urinary Tuberculosis.—Hesse⁴⁶ has collected a large mass of statistics on the frequency of urogenital tuberculosis. In 10,864 autopsies lesions of the genito-urinary tract were found in 2.13 per cent. Krzywicki⁴⁷ in 500 autopsies on tuberculous subjects

Combined with these measures, or with surgery, the patient should be given some urinary antiseptic (preferably sandalwood oil or hexamethylenamin), an abundant supply of liquids, a good cathartic, and a light diet

Meantime if he is suffering from one of the general infections already mentioned the treatment of this should go on as usual

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In an analysis of 154 cases of epididymal tuberculosis from the Massachusetts General Hospital, the writer⁷ found tuberculosis of the kidney in 18. Of these the genital lesion apparently preceded the renal infection in 11 whereas in 7 the kidney was probably first involved.

Keves⁴⁴ has reported 100 patients bearing 153 tuberculous epididymes. Among these renal tuberculosis had preceded the genital lesion in 11 cases while extension of genital tuberculosis to the kidney took place nine times.

From our material and from the literature I have gathered 1802 cases of genito-urinary tuberculosis. Most of them are infections of the genital tract alone; in others the urinary organs are also involved. Certain valuable deductions can be made from so large a mass of material.

Out of 821 cases in which the condition of the epididymis was described 617 or 75.1 per cent, were tuberculous.

The prostate and vesicles together were said to show tuberculosis in 1169 out of 1675 or 69.7 per cent while disease of the testicle was noted in 57.6 per cent of 739 cases.

Hesse's⁴⁵ statistics comprise 815 cases of urogenital tuberculosis collected from 17 different authors. The prostate was tuberculous in 550 or 68.5 per cent. According to Burekhardt⁴⁶ the prostate is invaded in 73 per cent of all cases of genito-urinary tuberculosis, a statement based upon the investigation of much material. As the only clinical method of detecting foci in the prostate is by digital examination there is a certain percentage of error, an observation which I find agrees with that of Hallé and Motz.⁴⁴ This error lies generally in the detection of small, early and centrally located lesions.

In his study of a series of 1494 autopsies of cases of genito-urinary tuberculosis Bothe¹⁸ found 65 per cent with prostatic involvement. This corresponds to the findings of Lowsley and Duff⁷⁴ who found the prostate involved in 68.9 per cent.

Young¹²² in a recent communication reports 50 cases of genital tuberculosis. The prostate and vesicles were involved in all; the epididymitis was unilateral in 14, bilateral in 31.

Certain authors claim to have found isolated prostatic lesions in considerable number. Out of a possible 642 cases I find that the prostate alone was regarded as tuberculous in 21.6 per cent. On the other hand Saxtorph¹⁰⁸ in a series of 205 cases of genito-urinary tuberculosis has reported only 9 such lesions, and Sawamura⁹⁸ from various sources collected but 11 more. After considering all the evidence, and with a large clinical and laboratory experience of his own, he thinks that the primary focus of genital tuberculosis may arise in the prostate, an opinion shared by K. M. Walker.¹¹⁵

On the other hand in 1911 George Walker¹¹⁷ whose opinion is backed by much experimental work, has laid much stress on the rarity of primary prostatic tuberculosis, and after reviewing the literature with great care found only 3 cases in which the primary focus undoubtedly lay in the prostate. One was reported by Crandon²⁸ and 2 others

found 5 per cent with involvement of the urogenital tract. Fowler and Godlee¹¹⁹ found 5.27 per cent, and Reclus,⁵² many years before, reported 12.8 per cent.

Quite startling is the statement of Uchimura,¹¹² that in 1830 autopsies on Japanese subjects, he found 629 cases of tuberculosis, the urinary or genital tract being involved in 210, or 33 per cent.

Bothe,¹³ writing in 1927, collected a large mass of statistics from various authors and found that in a series of many thousand autopsies upon patients who died from some form of tuberculosis the genito-urinary tract was involved in 5.13 per cent. In a group of 907 cases of genito-urinary tuberculosis 65 per cent showed evidence of an associated pulmonary lesion.

Lowsley and Duff⁷⁹ in 1930 reviewed an enormous mass of statistics. In a series of 52,070 autopsies they found an incidence of 2.1 per cent of urogenital tuberculosis.

In 1933 Sweany¹⁰⁷ reviewed this phase of the subject with great care. He states that genito-urinary tuberculosis is to be expected in about 1 per cent of autopsies for all conditions.

The above figures apply largely, if not entirely, to adults. In children the urogenital system is far less frequently attacked.

Poissonnier,⁸⁶ in a very complete review of the subject of infantile genital tuberculosis, collected 91 cases from various sources, the greatest number 44, having been observed by Broca⁷⁶ among 46,000 juvenile hospital inmates. Ritter,⁴⁶ in 1909, found but 14 cases among 5000 tuberculous children, Molliere and Augagneur,¹¹⁴ 1 instance in 183 cases of lung tuberculosis. The Massachusetts General Hospital has had 11 such cases from 1872 to 1920 among 401 admissions (including re-entries) for this condition, a percentage of 2.74. The figures from other sources give a proportion of urogenital tuberculosis in infants and children of about 1 in 200 cases of general tuberculosis.

Tuberculosis of the Genital Organs — The compilation of statistics is made a little difficult for the reason that the terms "genito-urinary" and "urogenital" tuberculosis are loosely used by almost all writers, and the general profession is only too apt to class under one of these names an infection of the genital tract alone.

Hinman⁴⁸ has pointed out (1928) that one of the characteristics of genito-urinary tuberculosis is its tendency to spread from one part of the tract to the other, regardless of whether the primary lesion is in the urinary or genital system. Thus one finds many cases with "genito-urinary" tuberculosis in which it is impossible to say where the primary focus began, this difficulty being intensified by the fact that the extent of a lesion cannot be taken as an indication of its duration.

While opinion is practically unanimous that the kidney is the first organ to be attacked in infections of the urinary system, there is less unanimity in the matter of the genital system. Most authorities agree that the primary focus is in the epididymis, certain others believe that the infection begins in the prostate, while a few put the burden upon the seminal vesicle.

abscesses represent 26 per cent of those so diseased. Randall's⁴ findings would be more convincing were it not for the fact that all died of a generalized acute or chronic tuberculosis, or of a pulmonary lesion. In only 1 of the 9 cases was the prostate alone involved; in the others the vesicles or epididymes or urinary tract shared in the disease and under these conditions I feel that no one is wise enough to say which organ was first involved. It is important however to realize from this study that the prostate can be invaded by tuberculosis in any one or all of its anatomical parts.

We have seen that the seminal vesicle like the prostate is invaded secondarily by tuberculosis with great frequency. Primary lesions on the other hand are apparently almost as rare as those of the prostate. This view is somewhat shaken by the fact that in 28.5 per cent of 287 cases, of the series of 1862 mentioned above, the seminal vesicle alone was said to be tuberculous. But what was said of the so-called isolated prostatic lesions applies to those of the vesicles, and careful scrutiny would undoubtedly eliminate most of the reported cases.

Young,¹² the most ardent advocate of the view that the seminal vesicle is the primary focus in genital tuberculosis, has collected much material from the literature to bear out his belief. He says, "Turning to the French literature I find that Guyon, the father of modern urology, stated many years ago that the tuberculous process begins generally in the seminal vesicles. He cited 26 necropsies in which the seminal vesicles were found to be primarily the site of disease; in 2 cases only the seminal vesicles were involved and in 10 cases the prostate was infected simultaneously with the vesicles. In 1 case the prostate alone was involved. In 220 clinical observations of patients suffering from urogenital tuberculosis which Guyon examined personally 40 cases were isolated genital tuberculosis, 74 were cases of tuberculosis of the urinary organs, and 108 were combined urinary and genital tuberculosis. In 127 clinical cases in boys suffering from urogenital tuberculosis before the age of puberty Guyon found the prostate involved in 56, prostate and seminal vesicles in 11, epididymes in 2 and all of the genital organs in 38. Guyon asserted his belief that the tuberculous process begins most frequently in the seminal vesicles and that the involvement was from within outward toward the external genitalia.

The statistics seem therefore to show conclusively that in the great majority of cases the primary involvement is in the seminal vesicles (or prostate) from which the epididymes or testicles are subsequently involved, the external disease being bilateral in from 30 to 50 per cent of the cases. In a probably larger percentage of the cases, the involvement of the seminal vesicles is bilateral (61 per cent of my cases in series B and probably higher).

That the seminal vesicle alone is not infrequently attacked by tuberculosis is shown in the investigations of Simmonds.¹³ He performed 40 autopsies in which the prostate alone was involved in 20, the seminal vesicles alone in 10 and the epididymis alone in 10. From this he

by Krzywicki⁶⁷ I¹⁰ have been fortunate enough to have such a case of primary prostatic tuberculosis, which was found to coexist with adenomatous hypertrophy of the gland. A somewhat similar case was reported by Koll,⁵⁸ and he in turn cites 2 other apparently authentic examples of this rare and interesting lesion. Practically all the other authors mentioned above, who claim to have found isolated prostatic tuberculosis, have based their conclusions either on clinical evidence, or upon the fact that although other foci were present in the genital tract, those of the prostate were further advanced and more extensive. I have already pointed out that clinical evidence is unreliable, and the consensus of opinion of experienced pathologists is that the apparent age of a tuberculous process does not necessarily determine its priority. I do not recall a single proved case in the genito-urinary clinic at the Massachusetts General Hospital, or am I aware that the autopsy records of the hospital contain one.

In recent years the most intensive study has been made by a number of investigators as to the frequency of primary prostatic tuberculosis. Bothe¹⁸ in 1927 collected 9 cases, these including the 5 already cited by me. As, however, only 4 of these 9 had complete autopsies the remaining 5 (including my own case) must be accepted only tentatively as actual instances of primary prostatic tuberculosis. In substantiation of his belief that primary tuberculosis of the prostate gland is an uncommon finding, Bothe¹⁸ states that the case he reports, namely tuberculosis of the prostate associated with adenomatous hypertrophy is the only one ever to have been found at the hospital of the University of Pennsylvania. He states further that no similar case has ever been observed at the Presbyterian Hospital in Philadelphia.

In 1928 McKenna and Sweany⁷⁵ studied 174 autopsies of tuberculosis of the genito-urinary tract. The fact that these patients died of tuberculosis, a circumstance which indicates that the disease was in its most advanced stage, somewhat vitiates their findings. They conclude from this study that "tuberculosis of the prostate is more common than the literature would lead us to believe." The study of their material showed that "primary tuberculosis of the prostate occurred in 4.2 per cent."

Lowsley and Duff⁷⁴ in 1930 reviewed all the evidence most carefully with the result that they were able to find "but one case in which tuberculosis of the prostate was undeniably primary."

In 1930 Randall⁸⁸ took up the question. He cited several authors, among them Lehman,⁸⁸ to whom he attributes the statement that "primary involvement of the prostate is frequent" and that "he could definitely show that in 17 instances of the 86 studied at autopsy the original focus was either in the prostate or seminal vesicle." Continuing along the same line of investigation Randall⁸⁸ studied 1215 post-mortem examinations, encountering among them 16 cases of abscess of the prostate. Nine of these were tuberculous, giving a percentage of 56.2 for the group of 16 cases. Randall⁸⁸ goes on to say that "as 343 patients of the autopsy series died of tuberculosis, those nine could

of the urogenital tract in others tuberculosis of the lungs, but healthy genitalia. George Walker¹² after a careful review of all the literature of this subject thinks that while tubercle bacilli may well find their way into the semen in the event of tuberculous genitalia there is no positive proof that they can be secreted by healthy organs. The subject is of some importance as undoubted examples of vaginal and cervical tuberculosis, arising apparently from sexual contact, have been reported.

Cunningham²³ states that in many clinical cases where the vesicles and prostate were typically tuberculous smears of the material expressed show tubercle bacilli in less than 15 per cent of the cases examined.

Herman⁴⁴ examined a patient who had the clinical evidences of a primary prostatic tuberculosis. Careful studies showed no demonstrable evidence of tuberculosis elsewhere. The patient's symptoms suggested simple interstitial prostatitis. On the other hand bacteriological studies of the semen showed the presence of tubercle bacilli on two occasions. There were no demonstrable changes in the vesicles or epididymes. The urine was normal at every examination.

Tuberculosis of Other Organs.—The frequency of a tuberculous infection of other organs preceding or accompanying that of the genital tract is well recognized.

In my series of 154 cases of tuberculosis of the epididymis, tuberculosis of organs other than those of the genito-urinary tract was found in 55.8 per cent. The lung was most frequently diseased with a total of 30 cases, 22.7 per cent of the whole. Kidney and bone infections came next with 7 cases each. I have also shown elsewhere¹ that the disease quiescent or active may be found in the joints, larynx, glands, meninges, middle ear, peritoneum and ischio-rectal fossa. It will be found in many cases that these lesions have preceded often for several years, the tuberculosis of the urogenital tract.

Keyes⁴⁴ found a previously existing process in 36 out of 100 cases as he gracefully puts it the disease is always sitting between bone and lung and urinary tract. Simmonds²⁰ in 35 cases of genito-urinary tuberculosis found lung infection in 27. Steinthal²⁰ in 24 cases found the lungs involved twenty-two times and Socin⁴⁰ forty-two times in 52 cases of genito-urinary tuberculosis. In 37 cases of the latter Oppenheim²⁰ found 81 per cent of lung involvement while in Reclus⁴⁰ cases it was present in 66 per cent.

To these impressive figures may be added others collected by Bothe¹⁸ wherein various authors are quoted as having lung tuberculosis in anywhere from 27 per cent to 85 per cent of cases of genito-urinary tuberculosis. In a series of 94 cases of epididymal tuberculosis Kretschmer⁴⁴ reported extragenital lesions in 79.8 per cent. In a similar study which involved 765 collected cases of tuberculosis of the prostate gland Lowley and Duff⁷⁴ found evidences of pulmonary tuberculosis in 57 per cent. Young's¹²² recent report of 50 cases of genital tuberculosis showed lung lesions active or quiescent in 55 per cent and renal tuber-

concluded that the primary focus in the genital tract proceeds from the seminal vesicle in one-quarter of the cases

Primary tuberculosis of the testicle is conspicuous for its rarity K M Walker and Hawes¹¹⁹ accept as authentic cases reported by Dufour,¹¹⁹ Langlet¹¹⁹ and Schmidt,¹¹⁹ while that of Barling^{117,119} is vouched for by these authors, as well as by George Walker¹¹⁹

Mark⁷⁶ has reported in detail a case of tuberculosis of the testis, apparently primary in that organ It is, however, to be noted that a second and more careful examination of the excised specimen showed a single tubercle in the epididymis "which differs in no respect from those found in the testicle" The pathologist also states that "from the appearance of the lesion in the testicle and epididymis one is not able to say with certainty which may be the older Histologically the processes in both are identical"

Tuberculosis of the glans penis may rarely occur (1) as an isolated lesion, (2) in association with tuberculosis of the genito-urinary tract or elsewhere, (3) by direct infection (circumcision, coitus) George Walker¹¹⁷ has collected 5 cases in the first group, 3 in the second group, and says "several (instances of infection from circumcision) have been noted in the Johns Hopkins Hospital" He has collected some 31 others from other sources I have not seen an example of it

Livermore⁷² (1928) states that he has seen "only a few cases" The lesion assumes two forms, lupus, which is superficial and similar to that of the face, the cavernous type, which is deeper and involves the erectile tissue Similar cases are reported by Yokohata,¹²⁹ Christeller,²⁶ Oraison,⁸² Zarubin,¹³³ Frontz and McKay³⁹

The question of infection from coitus has raised extensive discussion Pinaud⁸⁵ cites 4 cases of tuberculosis of the penis from fellatio Frank⁸⁵ and Kraemer⁸⁵ regard tuberculosis of the penis from normal coitus as impossible, on the other hand, Senn,⁸⁵ Oberndorfer⁸⁵ and Williams⁸⁵ regard such an infection as possible

Primary tuberculosis of the urethra is evidently an extremely rare condition One, apparently authentic, was reported in 1928 by Roederer⁹² Three others were reported by Rieben⁹⁰ (1927) Secondary infection with tuberculosis is not infrequently seen in the course of tuberculosis of the genito-urinary tract I have operated upon 1 or 2 such cases, and there have been several others, treated by dilatation, in the genito-urinary clinic at the Massachusetts General Hospital Asch,² Sawamura,⁹⁸ Uchimura,¹¹² Hallé and Motz⁴⁴ and others report several instances Such strictures often accompany bilateral renal tuberculosis In making a diagnosis of tuberculous stricture of the urethra, one must of course be very sure that the condition is not, after all, due to trauma or to an old gonorrheal urethritis

Tuberculosis of the vas deferens is found sooner or later in practically all epididymal lesions, especially on the side first involved Infections of the second vas are not so common, and develop later in the disease

Tubercle bacilli have been found in human semen, and in that of animals, by numerous observers In some cases there was tuberculosis

of the urogenital tract in others tuberculosis of the lungs but healthy genitalia. George Walker¹² after a careful review of all the literature of this subject, thinks that while tubercle bacilli may well find their way into the semen in the event of tuberculous genitalia there is no positive proof that they can be secreted by healthy organs. The subject is of some importance as undoubted examples of vaginal and cervical tuberculosis arising apparently from sexual contact have been reported.

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Tuberculosis of Other Organs.—The frequency of a tuberculous infection of other organs, preceding or accompanying that of the genital tract is well recognized.

In my series of 134 cases of tuberculosis of the epididymis, tuberculosis of organs other than those of the genito-urinary tract was found in 55.8 per cent. The lung was most frequently diseased with a total of 35 cases 22.7 per cent of the whole. Kidney and bone infections came next with 7 cases each. I have also shown elsewhere¹ that the disease quiescent or active may be found in the joints, larynx glands meninges, middle ear peritoneum and ischio-rectal fossa. It will be found in many cases that these lesions have preceded often for several years, the tuberculosis of the urogenital tract.

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culosis, unilateral or bilateral, in 28 per cent. These figures, while more or less repetitious, serve to demonstrate clearly the fact that the patient with genital tuberculosis is pretty likely to have one or several other tuberculous foci, and a lung process which has escaped the memory of the patient and the observation of the surgeon may not infrequently be uncovered by the unwise choice of ether as an anesthetic.

Pathogenesis—While two types of tubercle bacilli, human and bovine, may be found in man, a recent study by Eastwood and Griffith³⁵ would appear to show that the human type is alone found in lesions of the genital tract. These investigators examined 17 cases affecting the genitals in 9 (7 testes, 1 salpinx, 1 prostate) and 8 in the kidney. The bacilli found were of the human type in 14, and of the bovine type in 3. The latter were all found in kidney lesions.

In connection with this interesting and probably important question as to which type of bacillus is responsible for the lesions, one occasionally sees a case in which both organisms might be present. I refer to the patient who has had tuberculous adenitis in childhood, and who in later life develops tuberculosis of the genital or urinary tracts. Was the adenitis of bovine origin? If so, is the later lesion due to the same type of bacillus? The answer to this question can only be given by patient, careful research. The question as to how the tubercle bacillus reaches the primary focus in the genital tract is not yet definitely settled, still more in doubt is the path taken by the disease to its secondary foci.

I have shown that the relationship between genital tuberculosis and that of other organs, especially the lung, is very close, but there are occasional exceptions to this rule.

Baumgarten,¹⁴ v. Bruns,¹¹⁵ Kocher,⁵⁶ v. Braman,⁴ Durante,⁴ and Zigler⁴ have reported cases in which tuberculosis of the testis and epididymis was the only demonstrable focus in the body, while Kowalewsky⁶⁰ and Kraenzle⁶⁰ have found isolated, primary tuberculosis of the testicle (epididymis?) in bullocks. These are the only instances I have found of isolated genital tuberculosis.

I have no doubt that in the majority of cases the disease reaches its primary focus in the genital tract by way of the blood stream. Its attack upon the epididymis, the testicle or the seminal vesicle may be accounted for by the supposition that these organs have an excretory function, and that the disease gains a foothold upon a given organ at one time and not at another, because of either an overdose of the bacilli or of a lowered resistance on the part of the gland involved.

From an embryological standpoint, the testicle and the kidney are much alike, and there is ample proof that the latter may allow the passage of tubercle bacilli and other organisms without injury to itself.

The filtration of bacteria through an apparently healthy kidney has been demonstrated by many observers, among them Mayer,⁷⁹ Heyn,¹¹⁹ Kraemer,⁶² Buday,²¹ Wyssokowicz¹²⁸ and Rolly.⁹³ Brown²⁰ has collected many instances of lung tuberculosis, some in his own practice, where tubercle bacilli were found in the normal urine, and where later

the kidneys were shown to be free from disease. Some investigations by Cunningham²⁰ however do not seem to bear out these findings.

Belfield¹⁶ has shown that the testicle and epididymis are excretory organs. He says: "While the kidney is provided with a new and private sewer the ureter the testis continues to use the frog's old urinary duct now called epididymis and vas deferens." This excretory function of the testicle and its duct illumines both its intimate alliance with the kidney and its frequent infection from the blood. The writer⁷ has already shown in a study of infections of the testicle, that in certain cases the presence of organisms in both testicle and epididymis could be accounted for in no other way than by assuming that these organs had an excretory function.

There seems to be also considerable evidence that the seminal vesicle can assume an excretory role not only for tubercle bacilli but for other organisms as well.

Huet's¹⁰ experimental work has shown not only that bacteria are present in the secretion of the seminal vesicles of healthy animals, but also that in animals dying of acute sepsis the specific organism may be found in this secretion. The seminal vesicle may thus be looked upon not only as a reservoir for spermatozoa and a secretory organ but also as an excretory organ. Huet¹⁰, Simmonds⁴ and Spano¹² share this view.

There seems to be some evidence that the prostate also plays the part of an excretory organ. Jami and Nakarai¹¹ in 1886 and 1898 respectively found tubercle bacilli in the normal prostate of patients dying of lung tuberculosis.

I have seen a number of cases of acute infection of the prostate with the *Bacillus coli* there being no demonstrable focus of infection either in the kidneys, the bladder or the external genitals. I have regarded this infection as hematogenous, but whether it is to be regarded as an excretory effort on the part of the prostate I am unable to say.

Admitting that the epididymis is the primary focus is the subsequent prostatic infection of hematogenous, deferential or lymphatic origin?

While the tubercle bacillus may in certain cases be carried from epididymis to prostate by the blood stream it is more likely that the more direct route offered by the vas deferens or by the lymphatics is responsible.

At first sight it would appear that the spread of the disease through the vas in the direction of the seminal stream the descending or as some miscall it the ascending route, offered an easy explanation for the early and frequent prostatic involvement. While this view has many proponents, it is strongly assailed by numerous competent observers. Baumgarten¹² and his pupils especially Kraemer¹³ have been the chief proponents of the descension theory this opinion being based on much experimental and clinical observation. Among others who hold this view are Tylnski,¹¹ Cholzoff²⁷ Sugimura¹⁸ Sangiorgi¹⁷ Sawamura¹⁴ and Götzl.⁴⁰

While K M Walker¹¹⁶ regards genital tuberculosis as primary in the prostate, certain of his observations, both experimental and clinical, show that a flow of infected secretions through the lumen of the vas from the diseased epididymis may occur. This sets up a tuberculous process in the vas, most marked at its epididymal extremity, gradually shading off to normal tissue (unless the disease is of long standing) toward the external inguinal ring. My own observations and those of others have repeatedly borne out the truth of this observation. The only question is whether the advance of the disease has been intracanalicular or intramural.

Although in certain instances, the advance of the tubercle bacillus through the vas is possible, no positive proof can be shown, and the opponents seem to have the best of the argument. The fact that tuberculosis of the vas often obliterates its lumen near the epididymis before the upper part is involved, thus stopping the stream of secretion, at once places the proponents in an awkward position. Furthermore, how are they to account for the fact that even if the vas is ligated, the advance of the disease from epididymis to prostate may be delayed, but not stopped? This phenomenon has been observed in a number of animals by George Walker¹¹⁷. How, also, are they to explain my observations and those of Balliano,⁴ that the epididymis, prostate and vesicles may be tuberculous and the intervening vas perfectly normal.

These observations can be explained only by discarding the idea that the disease spreads through the lumen of the vas, except in certain instances, and by adopting the view that the lymphatics of the vas itself are to be held accountable for the spread of the disease in most cases, for, according to Téstut,¹⁰⁸ the lymphatics of the vas are very rich and voluminous, extending throughout its course.

That this theory is not without foundation is shown, I believe, by our experiences with bilateral vasectomy which is now done so frequently, almost routinely, in the course of a prostatectomy. It has been my experience and that of others, that in spite of vasectomy epididymitis will occasionally develop. When this occurs, as it sometimes does within a few days after vasectomy, it may be justifiable to ascribe its occurrence to the probability that a low-grade pre-existing infection of the epididymis is responsible. When, however, epididymitis occurs at an interval of several weeks after vasectomy, as I have seen it do, one must feel that the only explanation, aside from a haematogenous origin, lies in the fact that the lymphatics surrounding the vas were incompletely divided, thus leaving a path for the transmission of organisms from prostate to epididymis.

This hypothesis explains the phenomena just cited, as for example, the invasion of the prostate by tuberculosis in the presence of a normal or of a ligated vas. The possibility of this is explained by K M Walker¹¹⁸ who says "The bacillus of tubercle does not always indicate its presence in the tissue by the production of a tuberculous lesion."

"Structures may be shown under the microscope to be absolutely

free from signs of tuberculosis and yet nevertheless, have furnished the path along which the tuberculous invasion has progressed.

In certain cases of long duration the whole spermatic cord may be involved so that attempts to separate the vas from it may be either difficult where there are dense adhesions or impossible where all the structures are embedded in dense connective tissue. But in many early cases one may find an involvement of the prostate and vesicles in the presence of a normal or but slightly affected spermatic cord.

Although every argument presented here for and against the vas and its lymphatics can be refuted I think the evidence at hand favors the lymphatic transmission of tuberculosis from epididymis to prostate. I think the stream of secretions in the vas deferens is too scanty and sluggish to be a factor in the passage of bacilli. In such an event with organisms in contact with the entire length of the vas we should find one end quite as much involved as the other. But such is not the case. The epididymal extremity is first and most seriously invaded the pathological changes usually disappearing entirely as the inguinal canal is approached. To my mind this phenomenon is an evidence that the disease travels by way of the lymphatics.

I have already pointed out that tuberculosis of one epididymis is followed sooner or later by an involvement of its fellow in a large percentage of cases. I have been unable to settle the question as to the manner of invasion of the second side in spite of much clinical observation nor do I find that the extensive experimental work of others throws much light on the matter. The paths of communication—vascular deferential and lymphatic—are the same as before but the infection is now undoubtedly influenced by the presence of an already tuberculous prostate and seminal vesicle.

Many (Simmonds Bungner Kraemer Bruns Friedländer Volkmann Jordan and Zaimurawkin all quoted by Tylnski¹¹¹) believe that the infection of the second side like that of the first is hematogenous. Cholzoff¹⁷ also inclines to this view. The possibility of it cannot be denied.

While the ability of the tubercle bacillus to pass through the vas in the direction of its current has been shown to be doubtful the chances of its proceeding against the current must be even less. Yet I find that Ziegler¹ Teuschländer¹⁰⁹ Kuhn¹¹⁰ and Kocher¹⁷ consider this possible not only for the tubercle bacillus but also for the gonococcus and other non-motile organisms. A few of George Walker's¹¹⁷ experimental results with tuberculosis and a few clinical cases cited by him seem to bear out this view. If the passage of these organisms through the vas from urethra to epididymis does occur it can be accounted for only by a reversal of the normal peristalsis of that structure a phenomenon carefully studied by Oppenheim and Löw¹¹. It was observed in rabbits and guinea pigs and in one or two humans but did not occur in dogs. It was produced by stimulation of the hypogastric nerve or by irrigation of the verumontanum. Its experimental production is evidently not constant clinically it is certainly rare.

Epididymitis of gonococcal or pyogenic origin is occasionally seen when the sudden onset, a few hours after some otherwise trivial injury (such as the passage of a sound), cannot well be accounted for in any other way. I have never seen a tuberculous epididymitis begin thus, perhaps because the organism develops so slowly. Moreover, if a tuberculous process can, as has been shown, obliterate the epididymal end of the first vas, it can, by the same token, occlude the urethral end of the second vas by tuberculosis spreading from prostate or vesicles. Proof of this is offered by my observations^{5,6} and those of Keyes⁵⁴ that a very large proportion of men with tuberculosis of even one epididymis have azoospermia, indicating an obstruction of the genital duct on both sides. The pathological studies of K. M. Walker¹¹⁸ bear out this belief.

I should like to think with König,⁵⁹ Lancereaux,¹¹¹ Schmidt,¹⁰¹ and Sawamura⁹⁸ that the infection of the second epididymis is a simple case of transmission through vas, urethra, and vas, but the evidence against it is unimpeachable.

Unless one takes the view, as I am strongly inclined to, that the infection of the second epididymis occurs through the blood stream, possibly as an excretory phenomenon, the question narrows itself down, as in the case of the first epididymis, to the lymphatics as being the most probable bridge between prostate and epididymis. It is true that in such an event the infection must travel in a direction contrary to that of the normal lymph stream, but Balliano⁴ has shown that this can take place.

The following case, seen (September 15, 1915) by my colleague, Hugh Cabot, furnishes apparently substantial proof of the soundness of this theory.

A man, aged nineteen years, noticed a swelling of the right side of the scrotum about two years ago. In May, 1915, the right testicle was removed by another surgeon for tuberculosis, the vas being divided at a point opposite the external ring. About two weeks later the left side of the scrotum became swollen and tender.

Examination showed the right testicle missing. A sinus led to the stump of the vas, which was surrounded by a mass of indurated tissue. On the left side the testicle and epididymis seemed normal, but at the top of the scrotum, close to the vas and evidently connected with it, there was a hard, nodular mass the size of an English walnut. The urine was clear, but contained a few shreds.

Operation October 11, 1915. Left epididymis and testicle apparently perfectly normal. The lower end of the vas near the epididymis not thickened. Near the top of the scrotum there was an indurated mass, adherent to the vas and spermatic cord as well as to the overlying skin. This was excised, together with the epididymis and vas, up to the external inguinal ring. An additional length of vas was then removed through a counter-incision opposite the internal inguinal ring. The inguinal portion of the vas showed two caseous nodules, one of which was

removed. The vas was torn off (accidentally) at the second (distal) nodule which could not be reached over the pelvic brim.

The inguinal canal on the right side was then opened. The vas was isolated, drawn up over the pelvic brim, ligated and divided, thus

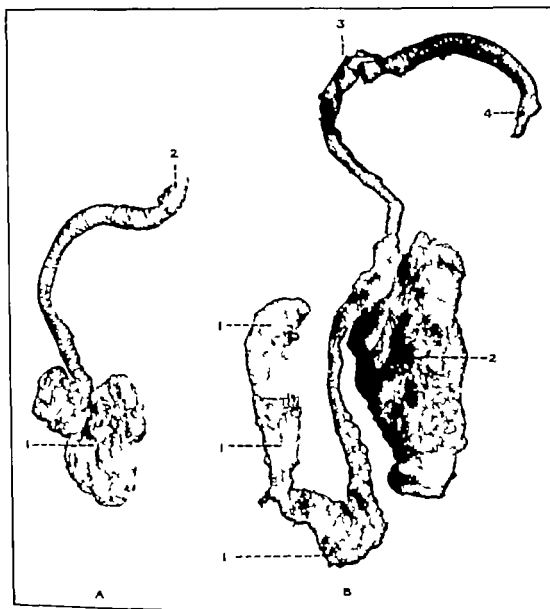


FIG. 261 — A right vas 1 proximal end with surrounding sinus 2 distal end divided at internal inguinal ring. B left epididymis, upper pole 1 body 1 lower pole 1 Mass of tuberculous tissue at upper part of scrotum 2 caseous, spindle-shaped nodule 3 lying within thickened vas, 4

removing the inguinal portion together with the mass of inflammatory tissue surrounding its stump.

The tissue excised from both sides is clearly shown in the accompanying photograph (Fig. 261).

Careful microscopic examination of the left epididymis shows no evidence whatever of tuberculosis or other inflammatory change. Section of the left vas lying between the epididymis and the large tuberculous mass are likewise normal. Beyond this point the vas shows various tuberculous changes.

The excised portion of the right vas also showed tuberculous changes.

Fortunately for our purposes the patient was seen when the advance of the disease upon the second side was in its initial stages and before the epididymis was involved.

Delli Santi³² injected tubercle bacilli into the urethra, and after three days demonstrated their presence in the testicle. Paladino-Blandini⁸³ obtained similar results. K. M. Walker and Hawes¹¹⁹ injected *Bacillus prodigiosus*, *Staphylococcus aureus*, and other organisms into the urethra of guinea-pigs. Eight to ten hours later they obtained cultures of these organisms from both epididymes, and got a scanty growth from the testicles and seminal vesicles. Especially important is the fact that positive cultures were obtained from the lymphatics of the vas deferens. Tubercle bacilli have also been demonstrated in the peridifferential lymphatics by Cholzoff.²⁷

Furthermore, it has been shown experimentally by Kappis⁵³ and Baumgarten¹⁵ that the spread of tuberculosis in a direction opposite to the normal stream of secretion can occur only if that stream is stopped. These observations coincide with the fact already noted, that the vasa deferentia are very frequently obstructed on both sides early in the disease.

When the prostate, testicle, or seminal vesicle is the primary seat of genital tuberculosis, there is no reason to suppose that its origin is different from that of the epididymal process.

In the event of renal tuberculosis, or of the filtration of tubercle bacilli through the healthy kidney, the prostate may be first invaded, with subsequent epididymal involvement, or the epididymis may be directly attacked. In either event the tubercle bacilli doubtless follow the same paths to the first epididymis which have been regarded as probable in infections of the second side.

Tuberculosis of the testicle, secondary to that of the epididymis, may arise either by continuity, by spreading against the seminal stream through the epididymal tubules or through the lymphatics. Here again, the latter course seems to be the most likely, but actual proof is lacking. Yet it is significant that the most frequent site of secondary testicular involvement is the body of Highmore at which point the lymphatics of the testicle concentrate (Téstud¹⁰⁸).

Since the question of the primary focus and of the means by which the disease spreads from this focus to other organs is still open to question, I think the views of two authoritative students of the problem, although at variance, are none the less interesting. After many years of study of this question and basing his opinion on the results of 200 necropsies of those dying with genital or genito-urinary tuberculosis Simmonds¹⁰² comes to the following conclusions:

1 The primary focus in the genital tract proceeds from the prostate in one-half of the cases, while in one-quarter of the cases it arises in the seminal vesicle or in the epididymis.

2 From these centers the process can proceed in the direction of the testicle or away from it.

Kraemer⁴² on the other hand believes that the spread of tuberculosis with the natural secretory current within the male genital system holds true, and finds not only no evidence against this view in Simmonds' work but even every evidence to support it.

The views of Hugh Young⁴³ still further complicate the problem. After an exhaustive study of the literature and of his own considerable personal material he says, 'The disease reaches the epididymis generally by the lymphatics of the cord from the seminal vesicles and first involves generally the *globus minor*. It is probably erroneous to suppose that primary tuberculosis of the epididymis often occurs. It probably seldom occurs through blood stream infections as is so often asserted. The seminal vesicles are not only the primary focus from which the epididymis are involved but from which also the prostate bladder and the kidneys in many cases are involved. In fact tuberculosis in the region of the prostate and vesicles is far more dangerous to the entire human organism than tuberculosis of the epididymis and is probably responsible for the fearful mortality which is variously estimated at from 27 to 60 per cent in cases of genital tuberculosis.'

Young⁴³ concludes his argument as follows. Statistics show conclusively that in most cases of genital tuberculosis the primary focus is in the seminal vesicles. Tuberculosis of the seminal tract is therefore, the better name.

From the seminal vesicles, the *globus minor* of the epididymis is generally next attacked.

From the seminal vesicles the prostate urethra and bladder are often attacked later.

From the seminal vesicles, more rarely the kidney may be invaded through the lymphatics along the ureter.

From the seminal vesicles by the posterior line of lymphatics the mediastinum and the lungs may be involved.

Tuberculosis of the seminal vesicles (ampullae and prostate if involved) ranks first in importance when a curative operation is proposed for genital tuberculosis.

Having followed the subject of genital tuberculosis for several years with great interest and care I still find no occasion to change my original belief in spite of much apparently disconcerting evidence to the contrary that the primary focus arises in the epididymis in the great majority of cases. I freely acknowledge that this focus may arise in the prostate or seminal vesicle in a certain number of instances but the old argument still holds true that the removal of the tuberculous epididymis produces clinical cure of the prostatic or vesicular process in the vast majority of cases. This being the case, is it reasonable to suppose that the primary focus lies in the one or the other of these organs rather than in the epididymis?

Pathology.—The microscopic picture presented by tuberculosis of the genital organs differs little from that seen in other tissue. Whereas elsewhere, notably in the lung, a tuberculous focus may often wall itself off and heal spontaneously, the tubercle bacillus seems never to cease its activity once it enters the genito-urinary tract. In certain cases it may remain quiescent for a long time (especially in the epididymis) bursting forth now and again with surprising violence, all the while replacing the normal tissue of the organ by a process of caseation and cicatrization.

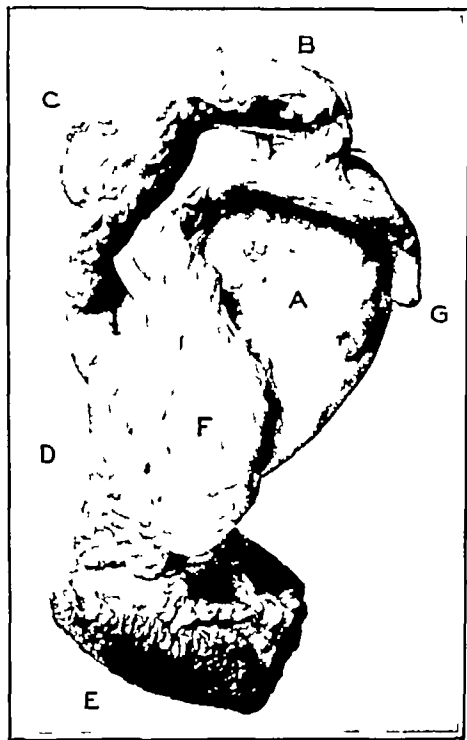


FIG 262 —Dissection of tuberculous epididymis. A, testicle, B, upper pole of epididymis, C, body, with tuberculous nodule, D, much enlarged lower pole, connected by a sinus with scrotal skin (E), F, nodular and thickened lower pole of vas, G, cut end of vas, slightly thickened (Specimen from Warren Museum)

It has been my observation that the tuberculous process attacks first the lower pole or tail of the organ. Cholzoff,²⁷ K M Walker,¹¹⁸ and George Walker¹¹⁷ report a similar experience. The early stages of epididymal tuberculosis have been well described by the latter in his experimental work. He says "The initial lesion begins just under the epithelial layer of the tubules. Soon there is an infiltration of the epithelium by small round cells, a few epithelial cells and leukocytes. This process progresses, the whole lining becomes disintegrated, and the lumen of the tubules is filled with exfoliated and adventitious cells. These soon die and are converted into tuberculous débris. The connective tissue framework becomes invaded secondarily, although there is an almost complete destruction of the epithelial lining before the connective tissue wall is affected."

The relation of the early stages of the tuberculous foci to the tubules has also been pointed out by Cholzoff,²⁷ but Tvlinski,¹¹¹ in tuberculous testicles of dogs, showed the tubercles to be in the interstitial connective tissue, especially in the neighborhood of blood effusions. An examination of a large amount of the material from our clinic has shown, generally speaking, that the tuberculous process was intertubular, involving only the surrounding connective tissue and leaving the tubules intact. In many sections the tubules were more or less compressed by the encroaching peritubular process, and in the later stages they showed evidence of complete destruction. The tendency of the tuberculous epididymis to form abscesses and sinuses is generally recognized.

These will generally be found at the lower pole of the organ (Fig 262), but in certain extensively diseased epididymies, purulent foci and even sinuses are to be seen at the upper pole as well, and occasionally in the intervening portion

It is apparently still unsettled whether the initial tuberculous process in the testicle begins in the canals or in the interstitial tissue. Many competent observers, Baumgarten^{12,13,22} Cholzoff²⁷ and others think it always commences in the canals or in their neighborhood whereas Samuel²⁸ after a careful pathological study of human testicles concluded that the disease spread by way of the interstitial tissue George Walker's¹¹⁷ experimental work throws light on this question He says

In those cases in which the animals had received injections into the aorta and had been killed within a short time afterward, I found in one gland several small capillaries containing tubercle bacilli and in another I observed very young tubercles close to the blood vessels. It is presumable from this that the organisms penetrate the walls and form a tubercle in the immediately surrounding tissues. This process may occur in the intracanalicular connective tissue or just under the epithelium As the process advances the tubercles coalesce and form distinct nodules

Balzano⁴ recognizes two forms of tuberculosis affecting the testicle and epididymis. The usual type is that which settles primarily in the epididymis, with the formation of single nodules This soon goes on to caseation abscesses and sinuses and is to be regarded as of hematogenous origin. The disease arises primarily in the interstitial tissue The second type evidently rare arises through the natural channels, urethra prostate and vas. It generally attacks epididymis and testicle simultaneously has its primary seat in the interior of the seminal canals and gives rise to an increase of interstitial tissue with round-cell infiltration and general increase of sexual tissue It somewhat resembles sarcoma. In advanced states there is caseation and destruction of the organ But if the resistance of the individual is high a clinical cure may occur with induration of the organ (orchitis fibrosa) resembling the obliterated and scarred tuberculous foci of the other organs so often seen at autopsy

The question of spermatogenesis in a tuberculous testicle has received much attention. It may persist until late in the disease Orth²⁵ says that in a tuberculous human testicle of which the center showed complete caseation one could recognize clearly the necrotic walls of the tubules, and in them in the midst of caseous nodules, one could see many spermatozoa Simmonds²⁶ has seen spermatozoa often in large numbers, in an extensively destroyed testicle Baumgarten¹² observed that while the tubules were more and more compressed and squeezed together by the development of inflammatory connective tissue and infiltration the epithelium itself still persisted and spermatogenesis was carried on by active karyokinesis

The microscopic appearances of the testicle when removed at operation may show an organ studded with milium tubercles, or it may pre-

sent a caseous or necrotic focus near its junction with the epididymis (Fig. 263) All observers agree that the testicular invasion generally begins at the body of Highmore (Fig. 264), when it spreads to other parts In certain cases, even with a long-standing and extensive tuberculosis of the epididymis, the testicular tissue remains intact and will be found compressed by the slowly enlarging epididymis as shown in Fig. 265 It not infrequently happens that a small and centrally located tuberculous process in the testicle will give no external sign of its presence For this reason exploratory orchidotomy is to be



FIG. 263 — Longitudinal bisection of testicle extensively invaded with tuberculosis. The disease follows roughly the fibrous septa of the organ. The bisected upper and lower poles of the epididymis are seen above and below in the median line. (Specimen from Warren Museum.)

recommended in doubtful cases. Yet in spite of careful macroscopic examination our experience has shown that 66 per cent of all testicles associated with tuberculous epididymes and removed showed microscopic evidence of tuberculosis.

Before leaving the pathology of epididymis and testicle it may be observed that an actively tuberculous process of the tunica vaginalis is occasionally found. The serous coat is deeply injected, there are innumerable tiny ecchymoses, and small tubercles may dot its surface or that of the epididymis. In practically every case more or less

hydrocolle fluid escapes when the sac is opened and its walls are adherent to a greater or less extent especially at the lower pole.

The pathology of the tuberculous prostate has been given much study. Experimental infections naturally show the earliest stages better than clinical specimens, especially as the latter are seen at autopsy when the disease is well advanced. The first changes begin just under the epithelial layer of the ducts. George Walker¹¹⁷ says of the subsequent changes: "After the formation of a considerable subepithelial aggregation the epithelium becomes invaded by the adventitious cells and the lumina of the ducts are encroached upon; later the lumina are



FIG. 204.—Longitudinal section of testicle and epididymis. Tuberculosis chiefly of the upper pole of the latter. Large tuberculous nodule in upper pole of testicle in the body of Highmore, the favorite seat of testicular tuberculosis. (Specimen from Warren Museum.)

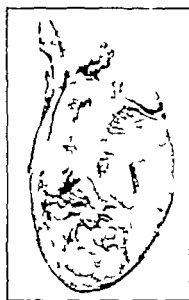


FIG. 65.—Longitudinal section of testicle and epididymis showing compression of the testicle by extensive tuberculous involvement of the lower pole of the epididymis. (Specimen from Warren Museum.)

filled with a mass of cells in which one can distinguish a large number of epithelioid degenerated epithelial small mononuclear cells and polymorphonuclear leukocytes. Very soon after this stage or in fact along with it, one sees a number of degenerated and dead cells; the nuclei are fragmented and the protoplasm is granular and cloudy. As this advances the cells are converted into a granular mass without any definite cellular differentiation. In the ducts the epithelial lining disappears leaving the walls made up solely of connective tissue. The prostate is converted into a number of cheesy rod-like masses interspersed among which is the connective and muscular tissue of the gland. This later breaks down and the whole gland is converted into tuberculous tissue.

Hallé and Motz,⁴⁴ with a large experience at the Necker Hospital divide the tuberculous changes of the prostate into

- 1 Small, primary tubercles
- 2 Large tubercles, which may present macroscopically a stage of softening, a stage of encystment, and a stage of fibrous induration.
- 3 Encysted tuberculous abscesses
- 4 Tuberculous cavities, partly or wholly open
- 5 A special form of massive infiltration, caseous or necrotic

The latter type seems to predominate. Careful pathological study shows that the tubercles are especially abundant in the middle lobe, but in more than half both lobes are attacked. Unilateral lesions are distributed without marked predilection for one or the other side. According to Reclus⁸⁹ and to Simmonds,⁴⁴ the early lesions are often unilateral in the lobe corresponding to the diseased epididymis. Anatomical facts do not clearly confirm this, but in the early stages it is hard to confirm.

Cholzoff²⁷ says that tuberculosis of the prostate occurs in the form of cheesy, degenerated tubercles of different size and rarely the whole organ shows homogeneous, cheesy degeneration. Involution of the disease he regards as rare.

Gotz⁴⁰ thinks the tuberculous prostate rarely, if ever, becomes encapsulated and calcified.

Hesse⁴⁶ classifies the changes in the prostate thus

- 1 The stage of tubercle formation
- 2 The stage of confluence of tubercles
 - (a) Caseation
 - (b) Abscess formation
- 3 The encroachment upon
 - (a) The periprostatic tissues
 - (b) The whole organism, as an acute military tuberculosis
- 4 The stage of healing

Albarran² recognized

- 1 Nodular infiltration
- 2 The cavernous type
- 3 The degenerative form.
- 4 Prostatitis with periprostatis

Many investigators, Hesse,⁴⁶ Lowenstein⁷³ and others, recognize a bacillary catarrh of the prostate as one of the earliest changes of tuberculosis. Macroscopically, there is nothing to be seen, and even the microscope may find but little alteration. The prostatic secretion, however, is loaded with virulent tubercle bacilli.

In view of the scanty descriptions of the microscopic anatomy of tuberculosis of the prostate it may be of interest to quote that furnished me by Dr F B Mallory, of the Boston City Hospital, in a case occurring in my own practice.¹⁰

Dr Mallory said: "It (the section of the prostate) shows a well-marked, fairly chronic, and typically tuberculous process, namely, military and conglomerate tubercles with giant cells and more or less

extensive areas of necrosis surrounded by endothelial leukocytes with an occasional giant cell here and there. The process has invaded the lumina of the glands and ducts of the prostate in places, and is extending along them.

Tuberculosis of the Seminal Vesicles — For a good description of the tuberculous seminal vesicles we are again indebted to George Walker¹¹⁷ whose experimental investigations have been most thorough. The earliest specimen he found was five days after inoculation. There is at first a diffuse injection of the mucosa with a few pin-point tubercles. These gradually enlarge to pin-head size in about twelve days. They fuse and finally cover the whole mucosa, on which there are tiny ulcers. Later there appears an exudate of a tough fibrous necrotic mass. This replaces the mucosa, and fills the lumen with semisolid grayish yellow material. The walls become invaded and much thickened, and composed almost entirely of tuberculous tissue. In the advanced stages there is an extensive adhesive perivesicular tuberculous process. In a few vesicles there were discrete fair-sized tubercles here and there with almost normal mucosa between.

Microscopically the disease is seen to begin just under the epithelium. There is a small aggregation of epithelioid cells together with a few small round cells leukocytes are added to these and there is finally formed a small olive-shaped mass of cells which raise the epithelium and shortly invade it. Sometimes there is an early invasion of the epithelium from the tissues below and the tubercles appear to be formed in the epithelial layer. In other cases the tuberculous process pushes directly upward invading the epithelial structures and protruding above the surface there is no epithelial cap and the whole of the minute papule is composed of tuberculous tissue. As the tuberculous process invades the epithelial layer a break occurs in the surface and an ulcer is formed. This gives rise to fibrinous yellowish exudate which often covers the whole surface with a thick, diphtheroid membrane. The whole epithelium disappears and the membrane rests directly on the submucous tissues. In advanced cases the walls are thickened with caseous infiltration and widespread destruction of muscle and fibrous tissue occurs. The process extends to the outside and involves the fascial covering.

This invasion of the perivesicular and of the periprostatic tissues is especially important. As I shall point out later it not only makes the removal of these organs difficult, but it also makes the complete ablation of the disease a futile effort. As seen at operation or autopsy the entire vesicle is generally found to be invaded by the disease and in most cases both organs are involved.

Although many authors do not recognize the possibility of the subsidence of a tuberculous infection of the prostate and vesicles there is no doubt that such an event usually takes place. My observations, as well as those of numerous other observers, extending over a number of years show a marked cessation in the activity of the infection of these organs (amounting to a clinical cure) after removal of the epididymes.

Herein lies one of the strongest arguments of those of us who regard the epididymis as the primary focus of genital tuberculosis. Also Lapeyre⁶⁹ has noted the tendency of the prostate to become encysted in fibrous tissue or to take on fibro-adipose changes. He found 19 such cures in 36 autopsies. Delore and Chahier⁷³ note especially the retrogression of prostatic and vesicular lesions after epididymectomy.

The condition of the vas deferens varies much. For a certain length of time it may show no tuberculosis at any point. Later the epididymal end becomes involved, the pathological changes gradually tapering off and finally disappearing as the inguinal canal is reached. Involvement of the entire vas from epididymis to prostate is evidently rare, if indeed it occurs at all. This statement is based upon many observations of my own and those of K. M. Walker and Hawes,¹¹⁹ and of Lapeyre⁶⁹. The former, believing that the prostate is the primary focus of genital tuberculosis, have shown that the infection spreads centrifugally from the prostate along the lymphatics of the vas. Whether this also occurs in secondary tuberculosis of the prostate I am unable to say, but I see nothing against it. At any rate we have the fact of a high percentage of azoospermia, even with a unilateral process, indicating pathological changes in, and obstruction of the vasa.

K. M. Walker and Hawes¹¹⁹ have shown that near the epididymis and for a certain distance beyond, sections of the vas show a ring of caseous material in the mucous lining, while the outer coats are intact. Farther up there may be no evidence of disease at all, while sections near the prostate will show infiltration, not in the mucous coat, but in the adventitia and more particularly in the lymphatics surrounding it.

In well-developed cases the vas, especially its scrotal portion, may present numerous and fairly regular fusiform swellings along its course, resembling a chain of beads. The surrounding tissues and other elements of the spermatic cord are stiffened and adherent, sometimes embedded in dense scar tissue.

Microscopically, according to George Walker,¹¹⁷ the initial process "begins just underneath the mucosa and extends upward, invading, and finally completely replacing, the epithelium. In this manner the whole of the epithelial layer is disintegrated and separated from the underlying tissues. The lumen then becomes filled with tuberculous debris, similar to that seen in the prostatic tubules and the ducts of the epididymis.

Tuberculosis of the urethra has been shown to be rare clinically, but it has been produced experimentally by a number of investigators. George Walker's¹¹⁷ experimental work showed three stages of the disease:

- 1 Very minute tubercles
- 2 Larger tubercles and ulceration
- 3 Caseous infiltration

As in all other tuberculous infections of the genital tract, the microscope shows the disease to begin "just beneath the epithelium, where there is seen a small cellular aggregation, which later invades the over-

living epithelium and forms the minute tubercle which can be seen with the naked eye an erosion of the epithelium soon occurs and a tiny ulcer is formed. The organisms at the same time invade the sub-mucous tissues, and finally the deeper tissues with the formation of caseous infiltration more or less widespread.

The organisms do not seem to invade the mucosa directly but it seems probable that the bacilli penetrate between the epithelial cells and lodge immediately under them. While trauma is certainly a predisposing factor, it does not seem to be essential in the production of stricture.

Tuberculosis of the Glans Penis—I have already shown that tuberculosis of the glans penis is occasionally seen infection at the time of circumcision and as some believe coitus, furnishing most examples. The disease takes the form of a chronic ulcer, as to the etiology of which all other organisms must be excluded. The microscope will reveal the nature of the lesion.

A picture of the widespread havoc produced by the disease once it has gotten outside of the genito-urinary tract, was presented by 3 of our patients who died of a general military tuberculosis following operation.

In one a boy aged six years with a unilateral process of two months duration practically every organ outside the genito-urinary tract was studded with miliary tubercles. The excised specimen showed tuberculosis of the epididymis (there was no note on the testicle) but strangely enough bladder prostate seminal vesicles and the remaining testis and epididymis showed no evidences of infection. There was a history in this case of an early tuberculosis of lung and meninges and its remains were found at autopsy.

The second case aged thirty five years had a more or less active process in the spine of six years duration. The epididymitis was right-sided and of unknown age. Autopsy showed old tuberculosis of right kidney and ureter bladder, pleura peritoneum bronchial lymph glands, spine seminal vesicles, and prostate with abscesses in the latter. Both testicles and the remaining epididymis were healthy. A cover-glass preparation of the seminal fluid showed no tubercle bacilli.

Our third case occurred in a man aged twenty years. The process was again right-sided its duration was said to be only a few days and the pathologist reported an infection of testicle as well as of epididymis. Autopsy showed a general military tuberculosis including the meninges. The bladder was uninfected as well as the left seminal vesicle and the left testicle and epididymis. But the prostate and right seminal vesicle contained abscesses and caseous foci.

I am now able to report* a fourth autopsy occurring in a child aged nine months, in the Children's Medical Service at the Massachusetts General Hospital. There was bilateral epididymitis. The child died of tuberculous meningitis unoperated. Autopsy showed tuberculous ulcers of the intestines of the mesenteric, retroperitoneal and bronchial

lymph nodes, and miliary tuberculosis of the lungs, liver, spleen and kidneys. There was also meningeal tuberculosis.

The epididymes were much enlarged and caseous throughout. The testicles showed no microscopic changes. The vasa deferentia were thickened to the size of a goose quill at the outer third of their length, whereas in the middle third there is no gross abnormality. The ampullæ are enormously distended. Both seminal vesicles, especially the left, are several times their normal size and on section are extensively caseous, there being but little normal tissue left. The prostate is of essentially normal size and appearance. On section it shows caseous areas within and immediately around the ejaculatory ducts throughout their entire course through the prostate. In one lateral lobe there is an ill-defined, partly caseous area occupying about one-fourth of the lobe.

Microscopic study of these organs was undertaken by our pathologist, the late Dr. James Homer Wright.

Prostate —The opaque areas in the region of the ducts are typical ejaculatory tuberculosis, with much necrosis. The opaque area occupying about one-quarter of the left lateral lobe shows small foci of necrosis in a cell-rich inflammatory tissue, in which are many epithelioid cells and some fibrous tissue. In the other lobe there are some small focal accumulations of epithelioid cells undergoing necrosis and constituting apparently recent tubercles. The microscopic appearance suggests a more recent process than in the ejaculatory ducts and in the epididymes.

Epididymes —The enlarged caseous epididymes show appearances of tuberculosis of more long-standing character. But little of the original tissue remains. As indicated by the gross appearance the tissue is largely necrotic, but actively growing tubercles are present at the margin of the necrotic mass in the fibrous inflammatory tissue. The testicles are normal.

Spermatic Cord —Sections from the median portion show appearance of tuberculosis.

It must be clear from this discussion of the pathogenesis and pathology of genital tuberculosis that many points are unsettled entirely, or are much in dispute. This ignorance and lack of agreement is due, not so much to a paucity of single or brief observations, clinical or experimental, as to a failure to study all the available material from beginning to end. The situation is well summed up by Hallé and Motz.⁴⁴ They say:

"A detailed mass of statistics, patiently followed up, on pulmonary tuberculosis on the one hand, and on genito-urinary tuberculosis on the other, from the earliest clinical symptoms to the ultimate issue, will furnish sufficient and certain conclusions. We do not yet possess such a mass of statistics."

McKenna and Sweany⁷⁵ (1928) have pointed out the need for a correlated study of clinical, pathological and bacteriological findings in genito-urinary tuberculosis. "By such a procedure only," they say,

will we be able to form a correct opinion of the onset, progress and termination of the disease in all its manifestations.

Etiology — Although the tubercle bacillus is the organism responsible for the disease in question certain conditions for its growth must generally be fulfilled before it can gain a foothold in the genital tract. These are

1. A lowered resistance on the part of the patient.
2. A previously existing tuberculosis of some other part of the body
3. A lowered resistance on the part of the particular organ or organs attacked

The first condition may be assumed to exist in any individual acquiring tuberculosis.

The second condition I have shown to be fulfilled in a very large percentage of cases.

While a lowered resistance on the part of the organ first attacked cannot always be demonstrated certain contributing factors can be shown to exist or to have recently existed in a considerable number of cases.

First let us consider trauma. Tyliniski¹¹ and others have shown conclusively in animals that this has a distinct influence upon the localization of a tuberculous process in an organ. In our material a definite history of injury to the infected organ was obtained in 18 out of a possible 92 cases. In tuberculosis elsewhere bone for example the outbreak of the disease is very frequently preceded by an injury.

Second infections of the epididymis or other organs generally gonorrhea, may be a predisposing cause in certain instances. Out of 95 cases of the series just mentioned 34 (35 per cent) had had an infection of the epididymis in the course of an attack of gonorrhea. A study of additional material has shown about the same percentage. Whether the initial epididymitis was of gonorrheal or tuberculous origin is hard to say.

Under exciting causes we should include ectopia of the testicle. This in itself may lower the vitality of the organ or subject it to trauma. Ferron¹⁷ and Le Dentu¹⁸ have reported cases of tuberculosis of such an organ. In 1927 Perard and Codet¹⁴ were able to collect but 3 cases of this nature from the literature.

Tuberculosis of the genital tract may attack the infant or the old man. One of my patients was eighteen months old another was a man aged seventy three years. Of 201 cases of genital tuberculosis collected by Hease¹² 2 occurred before the tenth year, 1 between seventy and eighty and 1 after the eightieth year. Between the twentieth and fortieth years he found 118 or 58.7 per cent, and from forty to sixty years 49 or 24.3 per cent. In other words 83 per cent were between twenty and sixty years old. In 120 patients (all with tuberculosis of one or both epididymes) I found 45 per cent between the twenty-fifth and thirty-fifth years. Sixty five of 96 cases reported by Keyes¹⁴ were between twenty and forty years old. Vignard and Thévenot¹⁴ have collected several cases of epididymal tuberculosis in infants. Two of

their own patients were respectively fourteen months and eleven months old, each with a unilateral process. These authors cite a case in a patient of Cholmeley's¹¹⁴ six months old, 1 of Hochsinger's¹¹⁴ thirteen months old, 4 of Launois's¹¹⁴ ranging in age from six to thirteen months, and 12 cases of Julien's¹¹⁴ in patients under two years of age. No mention is made of the condition of the prostate or vesicles in any of them. I have found 1 case, reported by Davids³¹ in a man aged eighty-five years.

In a study of the question of "Genital Tuberculosis in Male Children"⁹ I said, "various statements are made to the effect that the disease affects particularly very young children, decreasing in frequency as puberty approaches. Poissonnier,⁸⁶ among 89 cases, found 42 occurring before the second year, 47 between the second and fifteenth year. Among our 11 cases the youngest child was aged nine months, the other children being, respectively, aged eighteen months, two years, two and a half years, five years, six years, six and a half years, seven years, eight years, twelve years and fourteen years. That the nursing infant is not spared is shown by 2 such patients reported by Swoboda,¹¹⁴ and we are even informed that a case of this disease in a fetus at term has been observed by Drechseld (quoted by Poissonnier)"⁸⁶

I have already indicated the frequency with which secondary tuberculosis of the prostate and vesicles is found, but these figures apply chiefly to adults. All authors agree that before the age of puberty these organs are rarely attacked. Thus Kantorowicz,⁵² in 57 cases of epididymal tuberculosis in children, found the prostate involved but twice. In the cases under twelve to fourteen years of age (6 in all) coming under my own observation, I have seen no prostatic or vesicular tuberculosis. The combined experience of all observers shows that prostatic and vesicular tuberculosis is most frequent during the time of the greatest activity of these organs, *i e*, from about the twentieth to the fortieth year.

A study of juvenile genital tuberculosis which I reported in 1920⁹ is here quoted in the belief that the description of the findings in children is more complete than can be found elsewhere.

"In our series of 11 cases both epididymes were found to be involved at the time of entrance in 1 case (an infant, aged nine months), in another case (a boy aged eight years) the second side became involved twenty-seven months after removal of the epididymis first affected, while in a third case the involvement of the second side took place within three months after excision of its tuberculous mate (orchidectomy). These facts seem to be in accord with the views of other writers, especially Kirmisson⁵⁵ and Poissonnier,⁸⁶ the latter having collected only 7 bilateral infections out of 42 cases. Bilaterality of the disease in children is therefore far less common than in adults.

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band Vignard and Lhevenot¹¹⁴ assert that the testicle and epididymis are attacked simultaneously a view which is shared by Poissonnier,¹¹⁵ who states that the burden of infection is shared equally by these organs.

Our own experience shows that in only 2 instances was the testis itself definitely tuberculous, but it should be stated that the pathological reports more particularly those of an earlier day are very vague as to the differentiation between testicle and epididymis. I believe that there is much less frequently an involvement of the infantile than of the adult testicle and that in most cases it is no more necessary to remove the testicle of a child than that of an adult. Indeed it may be said that the removal of this organ from patients under the age of puberty should be done only as a last resort, with much less impunity than in the adult owing to the demand made on its invaluable internal secretion as puberty approaches.

While the formation of a scrotal abscess with spontaneous rupture and the establishment of a fistula may occur in children as in adults, it certainly is a far less common phenomenon. I have already showed that such an event takes place in over 70 per cent of adult cases whereas in the children under discussion scrotal fistula was found only three times.

While it is unfortunate that our records definitely state that the vas deferens was involved in only 2 instances there is no reason to believe that the seminal duct of children is less frequently invaded by tuberculosis than that of the adult. In the latter such an involvement is found in the great majority of cases, and according to Poissonnier¹¹⁶ the vas was definitely tuberculous in 18 out of 28 children in whom this point was noted.

It is unfortunate also that in so few cases is not only the condition of the vas deferens but also that of the prostate and seminal vesicles recorded. Since so much hinges on the knowledge of the condition of the latter organs not only from the scientific but also from the prognostic viewpoint it is disappointing to find that no mention whatever is made of these organs by many observers. While it is true that in children rectal examination is not easy and may be productive of pain the facts can readily be ascertained if and when the child is anesthetized for operation.

The records of our cases compare favorably with others in this respect, definite statements as to the condition of the prostate or seminal vesicles or both having been made in 6 cases, 2 at necropsy and in the other 4 either at or after operation. Of the latter, in a boy aged eight years the seminal vesicles were recorded as 'palpable' and very tender before operation whereas over two years later tuberculosis of the second epididymis and of one kidney having meantime intervened the record states that the prostate is normal and the vesicles are not felt. In a boy aged fourteen years with unilateral epididymitis of short duration it is recorded that nothing is felt in the prostate and in a child aged five years with a tuberculous epididymis

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While the formation of a scrotal abscess with spontaneous rupture and the establishment of a fistula may occur in children as in adults it certainly is a far less common phenomenon. I have already showed that such an event takes place in over 76 per cent of adult cases, whereas in the children under discussion scrotal fistula was found only three times.

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mitis of over two years' duration on the one side, and of from three to four months' standing on the other, we are told that the rectal examination was 'negative'. Finally, a boy aged seven years, having a unilateral orchidectomy in 1905, was examined at the hospital in 1911, and was found to have a normal prostate and seminal vesicles and the remaining testis and epididymis free from disease."

No statistics which I have seen give the incidence of marriage. Among our cases 66 per cent were married. Not that this is strange, for matrimony usually claims this number. But as it has been stated that the disease may be conveyed by coitus, I note that in not one of this number was there anything to suggest that marital relations were the cause of contagion.

The etiological factors already enumerated for tuberculosis of the epididymis will apply as well to that of any organ of the genital tract, whether primarily or secondarily involved.

Clinical Signs and Symptoms.—The clinical picture of tuberculosis of the epididymis which I present is based upon several studies of a group of cases from the Massachusetts General Hospital. They offer for consideration 210 tuberculous epididymes.

Duration of the Disease—Fifty-three per cent of the patients noted the presence of the disease within the six months preceding their appearance at the hospital, in a few it was a matter of only days or weeks. In 72 per cent the infection had begun within the previous year. Thence the time lengthens until from five to eight years have elapsed since the process began, and during which the smoldering fire has more than once broken into flame, only to be quenched with a poultice or a bag of ice. Moreover, nearly one-half of the patients acknowledged having submitted to more or less minor surgery in a vain effort to stamp out the disease. This interference was usually the tapping, often repeatedly, of a hydrocele, which so frequently accompanies the tuberculous process. In a larger number than one would like to see, the family doctor had merely lanced the abscess, thus prematurely giving birth to the sinus which is so common.

I would call attention to the fact that owing to the insidious nature of the disease, the patient can give, in most cases, no accurate answer as to the duration of his trouble. In this respect it is strikingly different from the epididymitis of gonorrhea, with its sudden onslaught. In a few instances the tuberculous process is ushered in with severe pain, tenderness and swelling, but even then one cannot be sure that the disease has not been going on for some time unknown to the patient.

On the other hand Wildbolz¹²⁶ believes that about 25 per cent of cases of tuberculous epididymitis begin with acute symptoms as in gonococcal or pyogenic infections. In the belief that one is dealing with one of these last named infections valuable time may be lost. But there are instances where one had better wait to be more certain of the diagnosis. In general the acute tuberculous process will perhaps subside in a few days, as will those with other types of infection, but the

infiltration will show evidences of retrogression to a much slower degree

Side Involved —The right side was affected in 59 (39.3 per cent), the left side in 47 (31.3 per cent) and both sides (at time of entrance) in 44 (29.3 per cent). Sixteen patients (10.6 per cent) after operation upon the first side, subsequently returned with tuberculosis of the second epididymis. There was therefore, a total of 60 (40 per cent) with bilateral disease, but it will be seen that the number of relapses was far less where the first epididymis had been previously removed.

Keyes²⁴ in a series of 87 cases has found a relapse upon the second side in 33 (38.0 per cent).

König²⁵ noted bilaterality in 7.5 per cent while Beck²¹ puts it at 27 per cent. v. Bruns¹¹³ found both sides involved in 38 per cent, while in 111 cases from the Tübingen Clinic the percentage was 29. Thus the chances of escape of the second epididymis are seen to be slim, but the management of the first epididymis seems to influence the fate of its fellow. Keyes²⁴ says: "Be the operation ever so slight or ever so radical, relapse upon the opposite side almost inevitably occurs. My figures show that relapse is less apt to occur if the first epididymis is operated upon."

Time of Involvement of the Second Epididymis —The time of involvement of the second epididymis after the infection of the first side varies considerably, but is usually not long delayed. In my series this point was ascertained in 49 patients. In 26.5 per cent it took place within six months, while in the first twelve months 38.7 per cent were so affected. In the remaining 34.8 per cent the number of relapses dropped steadily after the first year, but took place in a few cases as late as the eighth year. Keyes²⁴ cases show that 46 out of 63 infections of the second side occurred within the first year.

Eight of my cases (16.3 per cent) experienced an apparently simultaneous infection of both epididymies, ranging in duration from a few weeks to eight years before the patient sought relief.

It is therefore clear that the damage to the second side is an early event in most cases, but the danger is not entirely eliminated until after the lapse of at least eight years. It is also quite possible that the infection of the second epididymis may be so slight as to be overlooked at the time of operation upon the first side. This possibility is to be considered in one's statement to the patient of the condition and outlook of the second epididymis.

Results of the Disease —I have found that over 80 per cent of those questioned on the subject have lost weight. In some the depletion of flesh and strength was extreme, sometimes without demonstrable tuberculosis other than that in the genital tract. Per contra a few individuals had put on weight and appeared to be in the pink of condition.

Pain —This was noted in about 60 per cent of my cases. It was usually mild, often trifling. Generally speaking it was located in the diseased organ, but in certain instances was said to have extended

upward to the groin or even into the lumbar region. Radiation upward was usually the result of more or less extensive involvement of the vas deferens and other structures of the spermatic cord. More often than not its presence in the scrotum could be accounted for by the pressure of hydrocele fluid upon an acutely inflamed epididymis or testicle. In spite of the high percentage of tuberculous prostates and vesicles, I have noted practically no pain located in these organs or their vicinity. Pain in the region of the bladder may, however, be experienced during or at the end of micturition, and is found in cases of bladder tuberculosis of renal or prostatic origin.

During one of the characteristic exacerbations of the disease, scrotal pain may be intense, abating with the rupture of an abscess and the establishment of fistula, or by absorption of its products. Before such an outbreak of the disease there may be no pain at all.

As an accompaniment there may be tenderness, not intense, barring always the very acute cases, but generally speaking of only a moderate degree, its intensity doubtless regulated by the same factors which produce pain.

Fistula — This is one of the most common "earmarks" of tuberculosis of the epididymis, and is generally to be found in the skin at or near the lower pole of the organ. Fistulae at the upper pole are seen occasionally.

Seventy-seven and three-tenths per cent of 106 cases in my series had one or more fistulae in the scrotum. More often than not they were active, in others they showed a volcanic intermittency. The discharge is profuse at times, and is thin, purulent, and yellowish in color.

In 22.6 per cent of these 106 patients the scrotal skin was more or less adherent to the epididymis, and in some cases marked the site of an ancient fistula, long since inactive.

That fistulization is an early event is shown by an examination of the 82 patients in this series presenting this condition. In exactly 50 per cent the abscess had formed, ruptured and established a fistula within six months after the onset of the disease, while within the first year this had taken place in 71 per cent of the 82 cases. The progress of the disease is, therefore, not slow in most instances, but on the other hand I have seen several epididymes, tuberculous for eight or nine years, with a fistula of only a few days' duration.

Fever — An elevation of temperature before operation was noted in but 10 cases, the epididymes in these being in a state of acute inflammation.

Condition of Prostate and Seminal Vesicles — Owing to the proximity of these organs one to another, and to their close relationship, I believe that when the prostate is tuberculous, the seminal vesicles are also involved, or that they may be so regarded for clinical purposes.

The effect of the disease upon these organs has already been dwelt upon at some length, and I have shown that 76 of 101 rectal examinations in my series of cases revealed tuberculosis of the prostate and seminal vesicles.

A more detailed study of these cases has shown that where prostate and vesicles were regarded as tuberculous, epididymitis was unilateral in 38 and bilateral in 35 while in the negative cases one epididymis was tuberculous in 16 and both were involved in 9. From which it follows that prostate and seminal vesicles become readily involved in the presence of one tuberculous epididymis and before infection of the opposite side has had time to take place. In substantiation of this point I have data as to the condition of the prostate and vesicles and the known duration of the epididymal infection in 99 cases. In the first six months of the disease prostate and vesicles were found to be infected in 40 and healthy in 15 in the period from six months to one year 14 were positive and 3 negative. After the first year and in some cases after a period of six or seven years prostate and vesicles were tuberculous in 20 and negative in 7. Thus in the first six months of the disease 30 per cent are infected and in the first year 54 per cent. On the other hand one must not lose sight of the 7 prostates which are said to have held the enemy at bay for periods ranging all the way from one to six or seven years.

Bladder Symptoms and Condition of the Urine—With so frequent and early an infection of prostate and vesicles the bladder neck becomes irritable at an early date. In 16 patients (36 per cent) urinary symptoms such as frequency, dysuria and urgency were recorded while 43 per cent of 104 urines contained pus, blood and albumin. Also out of 10 urines with which the guinea pig was inoculated 8 showed the presence of tubercle bacillus. As in the absence of symptoms pointing to the kidney, cystoscopy and ureteral catheterization have seemed to us to be unwise it is hardly possible that some of these tuberculous urines were of renal origin. In this series there were recognized and operated upon 18 cases of renal tuberculosis, occurring at some time or other in the course of the epididymitis. The 8 tuberculous urines already referred to include none of these cases. It is probable therefore that the pathological urine and the bladder symptoms took origin from the prostate. This belief is substantiated by the observations of Lowenstein²² who in 18 cases of epididymal tuberculosis found tubercle bacilli in the urines of all. Renal tuberculosis was excluded as the source in every case and the prostate was regarded as accountable for the bacilli.

In 1928 Kretschmer²³ reported the urinary findings in 94 cases of tuberculous epididymitis. In 72 there was pus in 39 albumin in 23 red blood cells in 9 bacteria in 7 casts in 13 tubercle bacilli so proved by smear or guinea pig test or both. On the other hand only 10 patients were found to have renal tuberculosis at the time of operation.

As regards bladder symptoms Bumpus and Thompson²⁴ believe that dysuria is a symptom of urinary tuberculosis and does not occur when the disease is confined to the genital tract alone. They further believe that the presence of tubercle bacilli in the urine indicates renal disease and therefore that unless the urine is microscopically negative, cysto-

upward to the groin or even into the lumbar region. Radiation upward was usually the result of more or less extensive involvement of the vas deferens and other structures of the spermatic cord. More often than not its presence in the scrotum could be accounted for by the pressure of hydrocele fluid upon an acutely inflamed epididymis or testicle. In spite of the high percentage of tuberculous prostates and vesicles, I have noted practically no pain located in these organs or their vicinity. Pain in the region of the bladder may, however, be experienced during or at the end of micturition, and is found in cases of bladder tuberculosis of renal or prostatic origin.

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The effect of the disease upon these organs has already been dwelt upon at some length, and I have shown that 76 of 101 rectal examinations in my series of cases revealed tuberculosis of the prostate and seminal vesicles.

A more detailed study of these cases has shown that where prostate and vesicles were regarded as tuberculous epididymitis was unilateral in 38 and bilateral in 38 while in the negative cases one epididymis was tuberculous in 16 and both were involved in 9. From which it follows that prostate and seminal vesicles become readily involved in the presence of one tuberculous epididymis, and before infection of the opposite side has had time to take place. In substantiation of this point I have data as to the condition of the prostate and vesicles and the known duration of the epididymal infection in 99 cases. In the first six months of the disease prostate and vesicles were found to be infected in 40 and healthy in 15 in the period from six months to one year 14 were positive and 3 negative. After the first year and in some cases after a period of six or seven years, prostate and vesicles were tuberculous in 20 and negative in 7. Thus in the first six months of the disease 30 per cent are infected and in the first year 54 per cent. On the other hand one must not lose sight of the 7 prostates which are said to have held the enemy at bay for periods ranging all the way from one to six or seven years.

Bladder Symptoms and Condition of the Urine—With so frequent and early an infection of prostate and vesicles the bladder neck becomes irritable at an early date. In 45 patients (45 per cent) urinary symptoms such as frequency, dysuria and urgency were recorded while 43 per cent of 104 urines contained pus, blood and albumin. Also out of 10 urines with which the guinea pig was inoculated 8 showed the presence of tubercle bacillus. As in the absence of symptoms pointing to the kidney cystoscopy and ureteral catheterization have seemed to us to be unwise it is hardly possible that some of these tuberculous urines were of renal origin. In this series there were recognized and operated upon 18 cases of renal tuberculosis occurring at some time or other in the course of the epididymitis. The 8 tuberculous urines already referred to include none of these cases. It is probable therefore that the pathological urine and the bladder symptoms took origin from the prostate. This belief is substantiated by the observations of Lowenstein²² who in 18 cases of epididymal tuberculosis found tubercle bacilli in the urines of all. Renal tuberculosis was excluded as the source in every case and the prostate was regarded as accountable for the bacilli.

In 1928 Kretschmer²³ reported the urinary findings in 94 cases of tuberculous epididymitis. In 72 there was pus in 39 albumin in 23 red blood cells in 9 bacteria in 7 casts in 13 tubercle bacilli so proved by smear or guinea pig test or both. On the other hand only 10 patients were found to have renal tuberculosis at the time of operation.

As regards bladder symptoms Bumpus and Thompson²⁴ believe that dysuria is a symptom of urinary tuberculosis and does not occur when the disease is confined to the genital tract alone. They further believe that the presence of tubercle bacilli in the urine indicates renal disease and therefore that unless the urine is microscopically negative, cysto-

scopic examination should be made in all cases of tuberculous epididymitis

Hinman⁴⁸ believes that ulceration of the bladder is common in both renal and genital tuberculosis

Accompanying the bladder symptoms and the pathological urines in my own cases, prostate and vesicles were recorded as tuberculous in 28 and negative in 4. Furthermore, the relation of bladder irritability to the known existence of the epididymitis has been looked into in 43 cases. In 21, or 49 per cent, urinary symptoms were present in the first six months of the disease, whereas in the first year the figures jump to 27, or 62 per cent.

Condition of the Testicle — Sixty-six of the testicles in this series were found to be tuberculous. Forty-four occurred in unilateral cases, and only 22 where the process was bilateral. In other words, testicular infection is generally found in the early months of the epididymitis. Thus 60.6 per cent of the total number had become tuberculous in the first six months of the disease, and 83.3 per cent in the first year. That the testicle may resist invasion for a long period of time is illustrated by several cases in which the epididymal disease had existed for from five to eight years. These observations differ from those of Haas⁴³ and Lapeyre⁶⁹ who found the percentage of infected testicles to be progressively greater with the age of the epididymitis.

Condition of the Vas Deferens — It is unfortunate that physical examination often overlooks an important and an interesting feature of a case. This has been true with the vas deferens. I have notes as to its condition (mostly macroscopic) in 46 instances, 26 of these being on the side last involved. Of the latter 16 (61.5 per cent) were thickened for a greater or less distance upward from the epididymis, in some instances this being extreme. Fifteen out of 20 vasa (75 per cent) of the first epididymis to be involved were regarded as tuberculous.

While these figures are insufficient for accurate deduction, the fact that the vas of the epididymis last involved is less often diseased than is its fellow, would indicate that the tubercle bacillus reached the second side by the blood stream, or by the lymphatics.

Sex Function — I have mentioned elsewhere that 85 per cent of the patients whose semen has been examined have shown azoospermia, even with only one epididymis involved, an observation supported by the experience of Keyes⁵⁴. Further studies confirm this view. This condition is probably accounted for by an obstruction of the vasa deferentia, that on the still healthy side being doubtless involved at its urethral extremity by extension of the disease from the prostate. In fact the microscopic study of various pathologists has shown that the ejaculatory ducts are frequently involved even at an early stage of the disease.

Masculinity does not seem to be impaired even after double orchidectomy. Several of our cases bear out this statement, and Simon¹⁰⁴ says the sex function remained normal for from ten to twenty years in 29 of his cases of double orchidectomy for tuberculosis. It has also been

shown that spermatogenesis is persistent even in a testicle riddled with tuberculosis.

Sanford²² observes that while sex potency is rarely affected by genital tuberculosis, sterility is the rule even with the involvement of but one epididymis. This would suggest an occlusion on both sides in the vesicle. This in Sanford's opinion may be construed as an argument for the priority of infection of the vesicle.

One is cheered however by the statement of Bumpus and Thompson²³ who in a large series of cases of epididymal tuberculosis, found one patient with a bilateral lesion unoperated who subsequently became the father of two children. In 6 other cases unilateral and operated paternity occurred while 5 among a non-surgical group begot children. In 8 of these 11 the prostate was definitely affected.

I do not find any good description of the symptoms of primary prostatic tuberculosis much less primary tuberculosis of the seminal vesicle. By this I mean those instances in which there is no coincidental renal or epididymal tuberculosis. While there are those who claim that genital tuberculosis begins in the prostate or vesicle and who report a very considerable number of cases of this disease one cannot help wondering why they do not furnish us with a description of the early symptoms. It is unreasonable to suppose that there are no symptoms until late in the disease if they exist then their early recognition and an equally early intervention by surgery would go far toward eliminating the advanced disease which is usually encountered.

Difficulty of urination or possibly retention plus the evidences of tuberculosis would characterize a tuberculous stricture of the urethra. It has been my experience to find this lesion accompanying renal tuberculosis.

Diagnosis.—The diagnosis of a typical case of tuberculosis of the epididymis may not be difficult. Induration enlargement and nodularity of the organ especially at its lower pole associated with little or no pain or tenderness, is the usual clinical picture. If in addition one finds the corresponding vas deferens enlarged and irregularly thickened especially at its epididymal end and if the prostate and the seminal vesicles (particularly on the same side as the diseased epididymis) are likewise affected the case is undoubtedly one of tuberculosis. The chronicity of the disease or its bilaterality would help to confirm this diagnosis. If also there is bladder irritability and a hazy urine containing pus and tubercle bacilli all doubt is removed. The diagnosis is equally certain in the presence of an active fistula or the dimpled scar of one long healed.

In certain cases where there is more or less hydrocele it may be worth while to withdraw this fluid through a sterile needle and examine its sediment after staining for tubercle bacilli. I have seen these organisms in at least one case where the diagnosis had been under active discussion in the clinic.

In the hope that chemistry might throw some light on the diagnosis of obscure cases I have withdrawn the fluid from the tunical sac in a

number of instances and had it examined both qualitatively and quantitatively. Thus far there is no evidence that chemistry will enable us to distinguish between the hydrocele fluid of tuberculosis and that of other inflammatory conditions.

At other times the diagnosis must be in doubt until one or more of the features enumerated above comes to the rescue, or until removal of the epididymis and microscopic examination reveals the truth. The acute tuberculous epididymis may well be mistaken for that of gonorrhea or a pyogenic infection. Only a careful history, painstaking examination, and adequate observation will solve the problem.

But it should not be forgotten that an attack of gonorrhea which has escaped the patient's memory, an unobserved syphilitic infection of long ago, an infection of the epididymis in the course of a colon bacillus cystitis, or with a pyogenic organism from some septic focus elsewhere in the body, may each produce a picture not unlike that of tuberculosis.

Lesions of the scrotum are impossible to diagnose accurately at times by the most expert. In this connection I wish to mention 3 cases occurring in my own practice which have forced me to the conclusion that when in doubt it is best to operate and give the patient the benefit of that doubt.

The first case was that of a man, aged thirty years. For years he had been regarded as tuberculous and so treated, although bacilli had never been found in the sputum. I was asked to see him in consultation with a well-known surgeon who thought the patient had genital tuberculosis. My opinion coincided with that of the surgeon that there was tuberculosis of the left epididymis. I advised operation but this was rejected by both the surgeon and the patient, and hygienic measures instituted. While this treatment improved the general condition, that of the scrotum grew worse. The surgeon finally operated, removing a mass about the size of a tennis ball which the pathologist reported to be sarcoma. The patient died about three years later of metastases.

The second case occurred in a boy aged nineteen years. After an attack of measles, acute epididymitis developed and this was followed shortly by appendicitis for which an operation with drainage was performed. At this operation the mesenteric lymph glands were found to be greatly enlarged. As the epididymis did not subside, the boy consulted a well-known urologist who made a diagnosis of tuberculous epididymitis and advised expectant treatment. With a view to confirming this opinion I was asked to see the boy. I agreed in the diagnosis, but advised operation. This was refused. As the process did not subside the boy consulted a third surgeon who advised and later performed orchidectomy. Here again the pathologist reported sarcoma. As this occurred many years ago, and as the boy is still in splendid health, it seems probable that metastases have not occurred.

While my diagnosis was wrong in each instance, my advice was correct and if taken, it seems possible that the first patient might now be alive.

Since seeing these cases a third, almost identical case came under my

observation and was reported together with the two others in 1925.¹¹ In September 1934 Robertson and Gilbert¹² reviewed most thoroughly the subject of the coexistence of cancer and tuberculosis of the testicle. To the 7 cases which they found in the literature they added one of their own. These writers emphasize the point that diagnosis in the atypical case is often difficult mistakes are costly and that surgical exploration or irradiation should be resorted to in all doubtful cases. The routine use of the *quantitative Aschheim Zondek* reaction is advocated for a most accurate differential diagnosis of these conditions.

One can never be certain of the condition of the testicle. An increase in the size of the organ with nodularity of its surface may mean disease or may signify only an invasion of the overlying tunica.

If the evidence is in favor of tuberculosis or if the disease is clearly progressing an exploratory operation should be advised. The diagnosis of lesions within the scrotum are so uncertain, even when made by the most expert that the patient should be given the benefit of the doubt. If he has tuberculosis he is entitled to the earliest treatment if he has not tuberculosis he is entitled to the joy which that knowledge brings.

Prognosis.*—I have already pointed out the disastrous results of genital tuberculosis and their rapidity of occurrence. It has been shown that the second epididymis is attacked in 26.5 per cent within the first six months after the involvement of the first side that the disease invades prostate and vesicles in 30 per cent within the same time and that testicular tuberculosis within this period is found in 60.6 per cent. If one adds to these misfortunes the annoyance of bladder irritability and the affliction of sterility, the outlook is indeed gloomy. It is also to be remembered that a very large proportion of patients have the proverbial axe hanging over them in the form of tuberculosis of other organs.

Let us now see what encouragement can be held out to the patient with tuberculosis of the epididymis. I have traced 113 patients from one to twenty five years after operation. Over 27 per cent have died of some form of tuberculosis. Within a period of six years after operation 41 per cent of 58 patients have died of this disease. Of the deaths from tuberculosis 14.2 per cent occurred within one month 32.1 per cent within six months and 50 per cent within one year after operation. During the first six years 85 per cent died while between the ninth and eleventh years 10.7 per cent succumbed. Miliary renal and lung tuberculosis were in order the final types of the disease. A large majority of those dying of tuberculosis had had one or more outbreaks of the disease both before and after operation. My experience warrants the conclusion that until at least ten years have elapsed after operation no patient can be said to be cured of genital tuberculosis. The high percentage (14.2) of the total deaths from tuberculosis within a month after operation in the hospital deserves a word of explanation. There were actually four deaths within this period giving an operative mor-

For the views here expressed I shall quote freely from my paper on "The Ultimate Results of Genital Tuberculosis in the Male."

tality of 2.66 per cent for the total number of 150 cases. Operation was performed in all under ether, an anesthetic which is generally recognized as likely to stir up an otherwise quiescent focus of tuberculosis in the lung. I am convinced that were local novocaine, spinal or sacral anesthesia used, as has been the case this time, the mortality would have been far less. In fact I do not know of a death occurring in the past ten years in which these forms of anesthesia were used.

The record of the 60 patients now living (53 per cent) shows a much smaller percentage of other tuberculous processes before operation than do those of the dead, but many of them have since developed other foci. As 81 per cent of those examined and 28.5 per cent of those reached only by letter are still within the six-year period, in which I found that 85 per cent of deaths occurred, it is to be expected that the deaths from tuberculosis in this group are not yet at an end. The long life and good general condition of many of the patients, even though suffering from repeated outbreaks of the disease, shows that the survival of the patient depends largely upon his ability to immunize himself to the disease. Taken all in all, the odds are against the patient. The longer he can live and fight down any particular outburst of the disease, the better able he is, in most instances, to overcome the next exacerbation.

Among the cases analyzed here, epididymectomy, partial or complete, single or double, was performed seventy-eight times. In the remaining 35 orchidectomy, unilateral or bilateral, was performed. I have stated elsewhere on several occasions, as evidence of the efficacy of this operation, that not one of these patients had been obliged to submit to subsequent orchidectomy. Since this statement was made I have had 2 cases from which it was deemed necessary to remove the testicle within one month and two months respectively after epididymectomy. The pathologist reported tuberculosis of one gland, the other showed only a round-cell infiltration, and its removal was probably an error of surgical judgment. At the first operation there was no evidence in either case that the testicle was diseased. More recently I have seen 1 or 2 other similar cases, but in these the testis was definitely tuberculous and should have come out at the first sitting. Only the strong desire of the patient to preserve his organs led me to leave behind a testis which was obviously doomed. None the less it is amazing how much diseased tissue one can remove and how little healthy tissue one can leave behind with every reasonable assurance that it will become quiescent. What better proof is there of the efficacy of epididymectomy, even though we know that in certain of them a more or less infected testicle is allowed to remain?

I find that this experience agrees with that of Lapeyre,⁶⁹ Keyes⁵⁴ and Marinisco,⁷⁷ although the latter has had 6 of his unilateral epididymectomies return within two months for a secondary castration. The size, shape, consistency, and, in most cases, the sensation of the testicle are unaffected, and the benefit to the patient morally and physically is well worth the very slight chance of the necessity of a

secondary orchidectomy. I think we are apt to regard altogether too lightly the great value of the internal secretion of the testicle.

In this connection it may be mentioned that a tuberculous tunica vaginalis may assume an unexpected activity after epididymectomy. The clinical picture is very like that of an orchitis and in this belief orchidectomy may be advised or even done. There have been 3 such in my series, but in each a careful investigation of the situation and the free use of the curette has saved the testicle.

The very great incidence of sterility even with unilateral epididymal tuberculosis has been pointed out. I have no evidence that this condition is done away with in spite of an otherwise successful issue of the case. An involvement of one or both testicles does not seem to affect potency and this may continue even after bilateral orchidectomy.

Postoperative sinuses of the groin or scrotum are now a negligible factor in our experience. If the vas is divided in the region of the external ring where it has been shown to be tuberculous in many cases a sinus of several weeks or months duration is not unusual. By dividing the vas well over the pelvic brim at a point where with few exceptions it is free from disease no sinus will occur. Since the introduction of the technique of epididymovasectomy to be described later I know of no case in which even a temporary sinus from the stump of the vas has occurred. In a few instances there have been small and short-lived sinuses of the scrotum but they have readily yielded to time, tuberculin and hygiene.

In 69 out of the 113 patients whom I have followed the prostate and seminal vesicles were found to be tuberculous at the time of entrance to the hospital. I have since examined many of them at various intervals of time after operation. In most instances the induration, nodularity and tenderness, present before operation has subsequently disappeared entirely or much decreased. In a few the condition is the same as before operation. In 2 instances an abscess subsequently formed and opened spontaneously with the establishment of a perineal fistula from which urine has leaked at times.

The facts here presented are somewhat different from those of other writers. Lapeyre⁶⁶ says that 75 per cent of his cases are cured, and that a survival of the patients of from four to ten years after operation is to be expected.

Simon⁶⁴ has followed 92 cases from the Heidelberg Clinic. Fifty-four were found to be alive and free from tuberculosis but this disease had claimed 26 of the 33 who had died. Lung tuberculosis figured largely in the latter and was frequently found in those still alive.

v. Bruns⁶⁵ found bilateral epididymal tuberculosis in 38 per cent of his cases. Of those having operation on one side 23 per cent returned within three years for the removal of the second testicle. Of the single castrations, 12 per cent died of urogenital tuberculosis and 15 per cent died of tuberculosis of other organs especially the lungs. Forty-six

per cent of the unilateral cases were cured after three to thirty-four years

Of the double castrations, 15 per cent died of urogenital tuberculosis, and 25 per cent of tuberculosis of other organs, the lungs again being most often attacked. Fifty-six per cent of this group were cured after three to thirty years.

Berger¹⁷ has reported 60.4 per cent of cures after single or double castration, but does not state the time elapsing after operation.

Marion⁷⁸ has performed 1267 operations for genital tuberculosis since 1908. In only about one-tenth of these cases was the testis involved. He believes that epididymectomy is possible even in advanced cases. He prevents fistulæ by fixing the divided vas to the skin, and states that cicatrization occurs rapidly. Postoperative treatment is most important, a point emphasized by all authorities.

Wildbolz,¹²⁶ who has obtained satisfactory results by epididymectomy, states that more than 60 per cent were definitely cured and 20 per cent died of pulmonary, renal or other forms of tuberculosis.

In 150 cases which Wildbolz followed for many years there was no occurrence of tuberculosis of the testicle when it was not present at the time of operation. An important contribution to our knowledge of the efficacy of palliative treatment is that Wildbolz has removed the epididymis following treatment by these methods for from three to seven years, and has found many tubercles and virulent tubercle bacilli.

Felsenreich³⁶ followed 61 patients having epididymectomy or castration. Three years after operation 45 per cent were free from recurrence.

Hinman¹⁸ feels that in the majority of cases simple epididymectomy brings about an improvement or the arrest of lesions found to exist in the prostate, and states that tuberculosis of the seminal vesicles and prostate is rarely recognized in the absence of involvement of the epididymis.

Cholzoff,⁴⁷ who advocates epididymectomy, believes that this operation has a favorable influence on prostatic and vesicular tuberculosis.

Braasch,¹⁰¹ in discussing a recent paper by Young,¹³² states that his observations of patients at the Mayo Clinic convince him that the tuberculous epididymis should be removed before suppuration occurs, that in patients examined from five to ten years after epididymectomy cicatrization of the tuberculous prostate and vesicles has occurred except in very exceptional cases. He finds that the operation of epididymectomy is so satisfactory that the more radical procedures advocated by Young and others and to be discussed later, are unwise and unnecessary.

Turning now to those who believe that the primary focus of genital tuberculosis is in the prostate or vesicles, one finds that this view has far fewer advocates.

Young,^{130, 131} the most enthusiastic believer in this theory, asserts positively that the seminal vesicle is so frequently and so definitely the primary focus in genital tuberculosis that he speaks of the lesions as

tuberculosis of the seminal tract. He cites Whiteside's investigations, published in 1910¹² in which attention was called to the fearful ravages of testicular tuberculosis and to the ineffectiveness of resection of the epididymis. This view was based upon clinical and autopsy experience. Judging from the few end results related by Whiteside one is led to believe that the radical operation did not do much to relieve his own cases. In Young's experience the conservative operation (epididymectomy or castration) produced only about 19 per cent of cures. Young goes on to say: "The seminal vesicles are not only the primary focus from which the epididymes are involved but from which also the prostate bladder and the kidneys in many cases are involved. In fact tuberculosis in the region of the prostate and vesicles is far more dangerous to the entire human organism than tuberculosis of the epididymes and is probably responsible for the fearful mortality which is variously estimated at from 27 to 60 per cent in cases of genital tuberculosis. Therefore it is the duty of the surgeon to attack the most dangerous focus of involvement namely that of the vesicles and prostate. Therefore in tuberculosis of the seminal tract in the great majority of cases radical operation not only should be the operation of choice but also should be practically imperative.

More recently Young¹³ has summarized and emphasized his reasons for believing that genital tuberculosis begins in the prostate and seminal vesicle. He says —

In 1900 being convinced that seminal vesiculectomy was desirable in certain cases, I presented an extraperitoneal retrovesical suprapubic method of removing the seminal vesicles and epididymes. Although this technique was not difficult the results were not good because the drainage of the deep wound was unsatisfactory. Postoperative military tuberculosis occurred.

Having attacked the seminal vesicles in conjunction with the operation of perineal prostatectomy I again resorted to seminal vesiculectomy through the perineum in cases of tuberculosis.

After employing this technique for nine years, I collected all cases of tuberculosis of the genito-urinary tract in which operation had been done in the general surgical wards and in the urologic department. These studies proved to be of great interest. In the first place it was shown quite conclusively that tuberculosis of the epididymis began more commonly in the globus minor than in the globus major that it reached the epididymis probably through the lymphatics perhaps also by way of the vas deferens, but not often through the blood stream that the testicle was rarely involved until late and that castration was seldom necessary. This study showed also that in the majority of cases the seminal vesicles were involved or were surely the primary focus from which the tuberculosis spread to the epididymis in most instances that from the seminal vesicles the kidney was not infrequently involved by the retroperitoneal lymphatics and that from the same source the bronchial glands and the lung itself were sometimes invaded. These statistics showed conclusively that Kocher's assertion was true that an

operation on genital tuberculosis is indicated, even though the lungs are involved, that the more the external focus of disease can be removed, the better chance there is for the arrest of the pulmonary involvement

"In the same paper I presented a complete report of 15 cases in which my radical operation for tuberculosis of the seminal tract had been carried out. Among these, lung tuberculosis was present or suspected before operation in 7 cases, and renal tuberculosis before operation in 5, the operative mortality was 0. There was 1 death from lung tuberculosis twelve months after operation, and 1 patient had not been heard from. An excellent result was obtained in 13 cases.

"This report showed very conclusively that the radical operation for tuberculosis of the seminal tract, combined (if necessary) with epididymectomy, with castration and sometimes with nephrectomy, which had been carried out in 3 cases, showed very much better results than had been obtained by the partial operations of epididymectomy and castration.

"Very conclusive proof of the inadequacy of epididymectomy is shown in a later study of cases of unilateral tuberculosis of the epididymis, without involvement of the kidneys, ureters or bladder, and is as follows:

"Résumé of 38 cases of unilateral epididymectomy without urinary involvement. Dead, 11 cases, 29 per cent. Of those alive, 5 have been followed less than one year. Well on last report, five years or more, 6 cases, four years, 2 cases, three years, 1 case, two years, 2 cases, one year, 2 cases, less than one year, 3 cases, total 16, or 42 per cent. Well over one year, 13, or 38 per cent. Improved 5, or 13 per cent. Not improved 6, or 16 per cent. Of the 16 cases classed as well, all but 5 required other operations after the primary epididymectomy, viz. nephrectomy 4, epididymectomy on other side 7, radical operation seminal tract, 1. In 15 (40 per cent) we know that the opposite epididymis became involved subsequently.

"I have intentionally included the two previous sets of statistics to show how my early confidence in the radical treatment of genital tuberculosis has been confirmed by subsequent studies of cases. With the passage of time, and with successful results in cases far advanced or complicated with tuberculosis of the lungs or kidneys, or both, I have made bold to extend the operation even to cases in which the prognosis was manifestly poor, with the hope that at least local relief and prolongation of life could be obtained. There are a number of such cases in the 50 I am now presenting. Among these tuberculosis of the lungs was definitely diagnosed by roentgen-rays in 27 cases, 12 as active and 15 as inactive. Unilateral tuberculosis of the kidney was present in 14 cases and bilateral involvement in 1. Tuberculosis of the bones and joints was present in 4. Epididymal involvement was present, unilateral in 14 and bilateral in 31 cases. There were 5 cases in which there was no involvement of the epididymes. The prostate and vesicles were involved in all.

"Before the radical operation was carried out, the following opera-

tions had been done: epididymectomy unilateral in 3 and bilateral in 1; drainage of the epididymis 5; castration 11; nephrectomy 11. There were other cases in which vesical tuberculosis was present and in some cases perivascular sinuses and fistulas or infections which rendered the operation more difficult and hazardous.

The results obtained in these 30 cases are shown in the following summaries. There were 4 deaths in the hospital. In 1 of these there was a retrovesical abscess before operation and the patient died from tuberculous peritonitis. In the other 3 cases death resulted from complications of the lungs previously present. There were no operative deaths.

Dr Lloyd G. Lewis has made a very careful analytic study of these cases based on questionnaires and has also personally examined a good many of the patients. He has been able to follow 41 cases in which the radical operation has been performed. The results are as follows: Seven patients are living and well more than ten years after operation and 1 patient died after seventeen years of pulmonary tuberculosis which was present before operation. There are 7 patients who were operated on from five to eight years ago. Three of these are known to be free from tuberculosis, and 4 have been cured of genital involvement but still suffer from pulmonary lesions. Three patients died nine, eight and six years respectively after operation: 2 of pulmonary tuberculosis (which was present before operation) and 1 of diabetes. Nine patients have died of tuberculosis within two years after leaving the hospital: lungs, 3; kidneys, 1; meninges, 1; milium, 3; undetermined, 1. These patients had pulmonary tuberculosis as shown by roentgen ray examination before the radical operation was performed. Sixteen patients are living from one to seventeen years after operation. Of these 8 are free from tuberculosis and 8 have signs of tuberculosis elsewhere: vesical tuberculosis, 2; renal (bilateral), 2; colon, 1; lungs, 2; bones and joints, 1. All these complications were present on admission.

In determining the value of the radical operation in these cases, which have been tabulated and analyzed, one must consider the conditions present on admission. As stated tuberculosis of the lungs (active or arrested) was shown by the roentgen rays to be present in 50 per cent of the cases, unilateral involvement of the kidneys in 14 cases and bilateral in 1 and tuberculosis of the bones and joints in 4 cases. It is therefore evident that many patients included in this series were poor operative risks. The fact however that 27 of the 41 patients are living and that 16 of them are shown to be entirely free from tuberculosis and the others with only pre-existent involvement in other organs, proves conclusively the value of the radical removal of the entire seminal tract involvement.

Conclusions—A series of statistics have been presented which are in complete agreement as to the following facts concerning genital tuberculosis:

operation on genital tuberculosis is indicated, even though the lungs are involved, that the more the external focus of disease can be removed, the better chance there is for the arrest of the pulmonary involvement

"In the same paper I presented a complete report of 15 cases in which my radical operation for tuberculosis of the seminal tract had been carried out. Among these, lung tuberculosis was present or suspected before operation in 7 cases, and renal tuberculosis before operation in 5, the operative mortality was 0. There was 1 death from lung tuberculosis twelve months after operation, and 1 patient had not been heard from. An excellent result was obtained in 13 cases.

"This report showed very conclusively that the radical operation for tuberculosis of the seminal tract, combined (if necessary) with epididymectomy, with castration and sometimes with nephrectomy, which had been carried out in 3 cases, showed very much better results than had been obtained by the partial operations of epididymectomy and castration.

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and vesicles than in the epididymis. I would say that the reverse is true and I believe that statistics prove it.

I would agree with Braasch¹² who said in his discussion of Young's paper that the burden of proof still rests with Dr. Young in showing that the late mortality following complete removal of the genitalia is any better than when left alone.

In 1910 Whiteside¹²² reported 2 cases in which he had removed the entire genital tract with excellent results. In 1914¹²³ he reported 22 cases so operated but his own comments on the results are far from encouraging perhaps because he employed it in only the old and apparently hopeless cases—the very ones which it seems to me good surgical judgment would prompt one to avoid. Again in 1919 Whiteside¹²⁴ published a report of his progress with the operation and regrets that this first case is the only one of which I have certain knowledge that the remote result was successful. Several others have been under observation for months but none for more than two years.

Quincy⁴⁷ in 1918 detailed 7 cases of radical excision of the seminal tract for tuberculosis according to Young's technique without an operative death and with excellent immediate results. After reviewing all this one cannot but feel that while time may prove the wisdom of these radical procedures there is as yet not enough evidence as to their actual and ultimate value to make the average man desire to go through this ordeal himself.

Hinman⁴⁸ has reported his results in 13 patients with tuberculosis of the entire genital tract in which bilateral epididymectomy, vasectomy, seminal vesiculectomy and in some cases partial prostatectomy were performed. Two of these patients were dead both being poor surgical risks, 2 had not been traced and 9 were living and well. The results in these 9 patients have been satisfactory except for a perineal sinus which persisted for months to a few years in cases in which partial prostatectomy was performed. Hinman does not state how long after operation these patients were followed nor does he say what he means by a satisfactory result.

After reading the experiences of Young, Whiteside, Quincy and Hinman with the radical operation and in comparing these results with those of the conservative operation which have occurred in my own experience and in that of many other surgeons, I feel that one would have to be very persuasive in the matter of getting a patient to elect the radical procedure.

In 1931 after a very careful examination and evaluation of all the evidence as to the point of origin of male genital tuberculosis I came to the following conclusions. Now in 1935 having kept careful track of all the evidence accumulated since that time both through the literature and by clinical observation I see no reason to change my opinion.

In an experience of several years in the study of this problem I have found the most perplexing and conflicting evidence both clinical and anatomical. While I still believe that the great weight of evidence

"The disease arises more commonly in the prostate and vesicles than in the epididymis

"Genital tuberculosis is ultimately accompanied by tuberculosis of the lungs or kidneys in a large percentage of cases

"If the seminal vesicles are involved, adequate drainage is not furnished by the ejaculatory ducts, and from this region the disease progresses downward to the epididymis or upward to the kidneys or lungs

"The presence of renal tuberculosis, which has occurred in about 30 per cent of the cases, is no bar to carrying out the radical operation, in addition to nephrectomy, and curative results may thus be obtained

"The presence of old or recent tuberculosis of the lungs is often no contraindication to the radical operation, in fact, it is one's duty to assist, if possible, in the arrest of pulmonary tuberculosis by removing the external foci of tuberculosis

"If the disease is apparently localized within the scrotum, most careful examinations should be made to rule out involvement of the vesicles and prostate before relying entirely on epididymectomy, which generally will not arrest tuberculosis of the vesicles

"The radical removal of the seminal tract, both epididymes, vasa, vesicles and lateral lobes of the prostate is the operation of choice in the treatment of genital tuberculosis"

As one of those who regard the epididymis as the primary focus in genital tuberculosis I cannot help arguing a few of the points brought out in Young's paper

He states in the first place that "from the seminal vesicles the kidney was not infrequently involved by the retroperitoneal lymphatics" No proof of this can be given, nor does it apply in any way to those cases in which long-continued observation has shown that the renal lesion preceded the genital lesion Neither does Young's statement that "from the same source (the seminal vesicle) the bronchial glands and the lung itself were sometimes invaded" ring true All investigators, I think without exception, have expressed the opinion and have shown in their studies that genital tuberculosis was the result and not the source of lung or bronchial gland involvement The mere fact that tuberculosis of the lung or bronchial glands cannot be shown by clinical or roentgenological examination does not necessarily exclude it

While I do not hesitate to express my admiration for Young's skill in the execution of his radical operation and for his courage in carrying it out in patients with extensive tuberculosis ("poor operative risks" Young rightly calls them), I feel that it is important to observe that the tuberculous subject not infrequently proves to be highly immune to his disease, and while he may break out with a new focus first here and then there, he accomplishes the paradoxical feat of immunizing himself to the disease even more with each outbreak The follow-up of my own cases as well as those of many other investigators shows conclusively that quite as favorable late results are to be gained from the conservative as from the radical operation In answer to Young's statement that "the disease arises more commonly in the prostate

Does it do so? In the past ten years more than 100 cases of genital tuberculosis have been admitted to the genito-urinary service of the Massachusetts General Hospital. All but a few patients have had either epididymectomy or orchidectomy performed. There has been one death in the hospital in this time and this patient was not operated on. It would not appear therefore that conservative surgery involved a high death-rate. It is true that the ultimate deaths from tuberculosis are high and that at least ten years must elapse before the danger of dying from tuberculosis is past. Many of the deaths are from lung or general miliary tuberculosis. The radical surgeons claim that this high mortality is due to the tuberculous genitals which the conservative surgeons leave behind yet they have presented no evidence that this mortality did not arise quite as much from the original process in the lung or other organs which induced the genital tuberculosis as from the genital tuberculosis itself. Furthermore few if any of their cases have been followed a sufficient length of time to show what the outcome will be.

I have but few data of patients who have had no operative treatment. There were 11 such cases in the material that I have studied which were not operated upon for one reason or another. None so far as I am aware were given tuberculin or any special hygienic cure. Six died from tuberculosis 1 three months later 1 after ten years 1 was well a year later 1 died of apoplexy shortly after 1 cannot be traced. While these figures are too small to be of much value they show that the outcome was not brilliant. Hayes¹⁴ found 30 per cent of cures in 34 cases without operation and watched for more than three years. He says, "They would not be verified if the cases were more numerous" and I am inclined to agree with him.

Bumpus and Thompson²² in 1928 reported 42 non-surgical cases of genital tuberculosis, not operated upon (reasons not stated) as being well from five to seventeen years later. Only 7 of these found later operation necessary. Three had epididymectomy 3 had orchidectomy. One having the radical operation had to have 13 more later operations!

Turning now to the different methods of palliative non-surgical treatment one finds a considerable variety and with varying results. In the last edition of this book I laid considerable stress on the value of tuberculin. At that time (1924) we had been using it in all of our postoperative and some of our non-operative cases of genital and renal tuberculosis for a number of years. Its use was continued for some years after this but for some unexplained reason its employment gradually decreased until now it is seldom used. In 1924 I quoted O'Neal and Hawes¹⁵ who said

"Tuberculin injections are used in conjunction with other measures but in few if any cases would we be willing to attribute to tuberculin all or nearly all of the improvement. In some of the genito-urinary cases it has seemed as if tuberculin was an important factor in the treatment in the great majority of cases however while a factor it is by no means the most important one in producing results.

favors the origin of genital tuberculosis in the epididymis, I am willing to believe that in certain instances the primary focus may lie in the prostate, possibly even in the seminal vesicle. It is impossible to take up and discuss *seriatim* and *ad infinitum* the argument of the various proponents of each point of origin, more especially those of Young. One can only make generalizations.

"If genital tuberculosis arises in the prostate or even in the seminal vesicle, why is it that this disease is practically unknown clinically or postmortem? It is only reasonable to suppose that tuberculosis of either of these organs would produce symptoms for which relief would be sought and treatment given. Furthermore, prolonged observation of such cases would undoubtedly reveal the actual condition sooner or later. It is also true that in not a few instances necropsy has shown tuberculosis of almost every organ in the body, the prostate or seminal vesicles alone being spared.

"If the prostate or seminal vesicle is the starting point of epididymal tuberculosis, why is it that the removal of the epididymis has such a salutary effect on the other organs of the genital tract? I have followed many cases for a long period of time both before and after operation. While there have been occasional exceptions, as is to be expected, the prostate and vesicles which were nodular, indurated and enlarged before epididymectomy have eventually returned to an essentially normal condition. It is probably true that while the microscope would still show evidence of tuberculosis in some, it is equally true that fibrous changes eventually occur and a clinical and permanent cure is established. This statement is not a case of the wish being father to the thought, but is an actual statement of fact.

"In this connection one cannot avoid touching on the subject of treatment. The results just mentioned have occurred after epididymectomy or orchidectomy, yet there are those, of whom Young is the most recent and ardent, who urge the desirability of and the necessity for the removal of the entire genital tract. While this operation certainly gives free scope to the skill, patience and ingenuity of the surgeon, it apparently does not seem to afford an equal amount of satisfaction to the patient and after all, surgery should have this as one of its objects. If the prostate will quiet down spontaneously by a simple procedure, why remove the prostate? Also is it not against all surgical principles for a primary focus to subside after the removal of a secondary focus? Why not remove the entire ureter and the bladder as well as the kidney in treating renal tuberculosis? The procedure would be quite as logical. Or why not cure cancer of the breast by dissecting out the glands in the axilla?

"If the primary focus lies in the prostate or seminal vesicle, why are these organs less frequently attacked in children than in adults? Yet this seems to be the fact, judging from my own experience and from reports in the literature.

"The radical operation of removing the entire genital tract is thought to reduce the immediate as well as the ultimate mortality.

culin was undoubtedly helpful there were few if any standards for its use in genital tuberculosis.

Still another investigator Felsenreich¹⁴ reported a series of 23a cases of epididymal tuberculosis. Sixty-one were treated by conservative surgery. Fifty were treated by roentgeno-therapy and sunshine. It was found that frequent small doses were the most satisfactory, the temperature, general reaction, increased pain and swelling being the best indications as to the conduct of the treatment. In 32 per cent of 34 cases there were no recurrences; in 26 per cent recurrence developed within three months; and in 42 per cent it developed later. In the latter group 8 patients died, 6 of pulmonary, 2 of military tuberculosis. This experience led Felsenreich to the conclusion that in the presence of extensive pulmonary tuberculosis roentgen ray treatment was better than surgery. This author treated still another group comprising 35 cases, with conservative local measures consisting of sunlight and iodine ointments. Only the severest cases were included in this group and there was a mortality of 40 per cent within two years. In the entire series the patients who died or had recurrence had pulmonary tuberculosis.

In the last edition of this book I cited the experience of Wildbolz¹⁵ with heliotherapy in 13 cases of epididymal tuberculosis. This treatment was continued from eight months to two years under the best conditions. Microscopic examination of the organs removed at a later time showed not the slightest evidence of reparative processes.

Freund¹⁶ in 1921 described his experience with 15 adult cases of genital tuberculosis of whom fistulae were present in 7 treated solely by roentgen ray. He stated that tuberculous tissue was not sensitive to this agent and that whatever favorable effect it might appear to have was to be found in its stimulating effect on normal granulations. In spite of this observation Freund concluded that roentgeno-therapy can be relied on to accomplish a radical cure if the process is confined solely to the testis and epididymis. If on the other hand the process has spread to the vesicles, prostate, bladder or kidney, roentgen ray may at least check further development, close up fistulae and prevent its spread to the opposite side. He wisely adds however that in certain cases partial resection of local foci may well precede roentgen irradiation.

Treatment.—This may be divided into (1) expectant or palliative, (2) conservative and (3) radical. As the results of these different forms of treatment have been rather freely discussed in the section on prognosis it is necessary now only to give the details of their execution.

In regard to palliative treatment no great amount of description is necessary, as not only have the various types of such treatment been enumerated, but also in a general way the method of using them. It is important to realize however that palliative treatment should be reserved only for those cases where operative treatment is refused or where it is for some reason impossible.

In addition to one or more of the palliative methods described it is

I am inclined to believe that while tuberculin does no harm if properly and carefully administered (there are many who consider it absolutely dangerous), it probably is but a relatively minor factor in the list of palliative measures. Yet I must confess that apparently under its influence I have seen sinuses close quickly, urinary symptoms improve and a marked gain in the patient's general condition take place. But other factors such as sunshine, ultraviolet light, diet and fresh air, used in conjunction with tuberculin, undoubtedly played quite as important a part in the patient's recovery.

I said in 1924 that while I have a high opinion of tuberculin as an adjunct to the postoperative care of genital tuberculosis, I advised strongly against it as a substitute of operation. Some of the older French writers, however, favor it highly in the expectant treatment of the disease. Lelongt,⁷¹ writing in 1911, quoted the statistics of Mantoux,⁷¹ based on 70 cases of genital tuberculosis treated in this way. He considered them encouraging when one realizes that they had no hope of improvement by surgical treatment. These cases were said to be cured in 33 per cent, much improved in 48 per cent, not changed in 11 per cent, while 8 per cent died. No details were given, especially of the time during which the cases were observed, and without these facts one is skeptical.

Wildbolz¹²⁶ has reported the use of various conservative methods of treatment including tuberculin, roentgen-rays and heliotherapy. Even after the use of conservative, non-surgical methods for one or two years, he was not certain that recovery was complete. He removed the epididymis after three to seven years of conservative treatment and found many tubercles and virulent tubercle bacilli. He feels that in those cases where cure is reported from the use of these methods, they were examples, not of tuberculous, but of chronic, non-tuberculous epididymitis, the differential diagnosis of which is often difficult.

Ullmann¹¹³ in 1928 reported 43 cases of genital tuberculosis in which roentgen-ray treatment had a beneficial effect. Swelling and infiltration decreased in a short time in most of them, and there was also noted a marked improvement in the condition of the prostate, the vesicles and the scrotum. Ullmann went so far as to say that irradiation of the normal testicle prevented the spread to it of tuberculosis from the diseased side. Altogether this report sounds most promising, but one would like to have more detail as to the length of time his patients were observed, what the microscope would show in the organs so treated, and whether there were any endocrine changes.

Wang¹²⁰ writing on the use of tuberculin in 1930 feels as many others do that it is difficult to evaluate the results obtained when, as is usually the case, it is only one of other palliative measures. In a series of 55 cases (some of them postoperative or pre-operative) 39 were improved, 8 did not improve, and 7 retrogressed. One of the patients died. In addition to tuberculin these patients were given mercury—vapor—quartz light, and other treatment. Wang concluded that while tuber-

6 All traumatic manipulations and irritative drugs should be avoided in the treatment of genito-urinary tuberculosis.

For the exact method of giving methylene blue orally the reader is referred to the original articles of Greenberg and his associates.

Finally another method of postoperative or purely palliative treatment has gained favor in the past eight or ten years namely the use of quartz light therapy. This has been studied at length by Wang.²¹ He reports favorable results in the matter of healing sinuses and quieting down the irritable tuberculous bladder. It is to be noted however that this treatment must be continued over a period of months and sometimes of years, and also Wang says "There is no way of appraising the value of the procedure. It is further made difficult by the fact that it is only one measure in a general regimen of care.

By conservative treatment I refer to the removal of the epididymis together with as much of the vas as is easily accessible, and where necessary the testicle.

The history of operations upon the epididymis has been written by Marinisco.²² Recognizing the evil effects, mental and physical of castration especially when bilateral and acknowledging the importance of the epididymis in genital tuberculosis Bernard²³ in 1834 performed the first partial epididymectomy. In 1861 Malgaigne²⁴ as well as Jobert²⁵ and de Lamballe²⁶ were performing a complete and extensive excision of the epididymis. Bardenheuer²⁷ in 1880 is credited with the first real description of epididymectomy and he showed its value in a series of 34 cases.

Villeneuve²⁸ did the first epididymectomy in France in 1889 and emphasized the great value of the testicle for its internal secretion as well as for its psychic effect.

While the French surgeons were doing their utmost to preserve the testicle the Germans, with one or two exceptions continued their habit of promiscuous castration. Unfortunately their example has been copied all too widely and even today the general surgeon other wise sound and conservative removes the testicle when by a simple operation this valuable organ can be preserved to the patient.

For the technique of epididymectomy better called epididymo-vasectomy we are indebted to Cabot²⁹ whose description of the operation I quote. This procedure can be done in most cases with novocaine local anesthesia but in a few patients, with an acutely inflamed scrotum or of neurotic temperament I feel that one should not hesitate to use spinal or sacral anesthesia perhaps in preference to gas-oxygen certainly in preference to ether.

The local preparation of the patient should involve the skin of the scrotum and the groin of the corresponding side if the disease is unilateral. An incision is made over the epididymis about 2 inches long. If sinuses are present, they should be circumscribed by the incision. This is carried down to and opens the tunica vaginalis, which will in many cases be found adherent to the testicle and must be separated by dissection. The testicle and epididymis are delivered from the

important to employ the time-honored measures for the treatment of any tuberculous condition, *i e*, regulation of diet, fresh air, sleep, exercise, etc. It follows therefore that if the patient undergoes an operation, whether conservative or radical, he should receive in addition whatever benefit is to be gained from the best of hygienic conditions together with whatever form of palliative treatment seems best suited to his case. For it should not be forgotten that whether conservative or radical measures are carried out, the patient still has tuberculosis and should be treated accordingly.

In discoursing upon the virtues of palliative treatment, especially heliotherapy and roentgeno-therapy, von Schmieden¹¹⁶ brings out what I believe is an important point, namely that patients with discharging sinuses and tuberculous bladders should be as careful of the disposition of the pus and of the urine, and incidentally of the semen, as the lung patient of his sputum.

If during the progress of the disease hydrocele develops, it should be aspirated not only for the comfort of the patient, but also in order that the surgeon may more accurately estimate the size and condition of the underlying epididymis and testicle.

Bladder irritability, a not uncommon and sometimes most distressing symptom, must also have attention. There are various measures which may help, among them being sandalwood oil in 5 or 10 minum capsules, thrice daily after meals, 6 per cent warm carbolic acid solution as an irrigation (Rovsing), bichloride of mercury, 1 to 10,000 up to 1 to 1000 as a bi-weekly instillation, or perhaps better the perchloride or oxycyanate of mercury (Guyon). Potassium iodide internally, followed after a few hours by the instillation of calomel emulsion in oils and instillations of 20 per cent lactic acid are among other methods which have been recommended. The recent intensive studies of the value of methylene blue by Greenberg, Brodny, Davis and Armstrong⁴¹ seem to have placed this old, but somewhat discredited therapeutic agent on a new and firmer footing. Briefly it has been found that the dye usually obtainable contains impurities which are irritating to the stomach. That which conforms to the standards of the U S Pharmacopeia is the best now obtainable. These authors have reached the following conclusions:

- 1 Methylene blue alleviates the symptoms of urinary tuberculosis more effectively than any other drug we have used.

- 2 Clinically, methylene blue increases the appetite and weight of patients with urinary tuberculosis.

- 3 Methylene blue is valuable in the diagnosis of renal tuberculosis. Tuberculous cystitis must be considered as a probable diagnosis in those patients in whom the symptoms of frequency and burning are markedly relieved by the dye therapy.

- 4 Alkalies are useful in combating and neutralizing the highly acid urine which is characteristic of urinary tuberculosis.

- 5 Vesical instillations of sterile mineral oil exercise a bland, soothing effect mechanically on the tuberculous bladder.

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wound The epididymis is then separated from the testicle by a scissors dissection, as in this way the vessels which lie behind the epididymis are less likely to be destroyed The separation should be begun at the upper pole and carried downward, the epididymis being separated from within outward When it is free, the lower inch or two of the vas should be stripped up by blunt dissection from the structures of the cord A curved clamp is then applied to the vas and the epididymis, and the lower inch or two of the vas cut away The vas is then stripped up by blunt dissection with the fingers so as to free it from the structures of the cord up to the external inguinal ring Guided by the finger, the clamp on the lower end of the vas is then passed up to the external ring and carefully inserted into the canal, care being taken to avoid pushing it in front of the canal between the fascia and the fat The clamp is then pushed upward and outward following the line of the inguinal canal until its tip lies directly beneath the fascia at the level of the internal inguinal ring The handle of the clamp is then strongly depressed, bringing the point snugly against the skin An incision not over $\frac{1}{2}$ inch in length is then made on the point of the clamp, which is then pushed out through this incision carrying with it the distal end of the vas The vas is then picked up, the traction is made so as to pull out the portion lying in the canal so that the remaining portion dives vertically into the wound and over the brim of the pelvis The finger is then inserted into the little wound, and the vas is freed as far as the finger can reach, making steady traction during this process A right-angled clamp is then applied to the vas at the lowest accessible point It is divided, cauterized, with phenol (carbolic acid) ligated and dropped back The wound in the groin is closed with one catgut suture in the fascia, with a silkworm-gut stitch in the skin The operation is completed by the careful ligation of any bleeding-points in the scrotum Any apparent foci in the testicle are eradicated with a curette The wound is painted with tincture of iodine and closed with a subcuticular suture of silkworm-gut, leaving a small protective-tissue drain at the lower angle This drain has been found to shorten convalescence by giving free exit to the serum which necessarily oozes from the raw surface, the amount of which is considerably increased by the application of iodine The dressing is held in place by the application of an Alexander bandage, one of the many devices of the late Samuel Alexander, which has been a boon to the genito-urinary surgeon The drain can generally be removed in forty-eight hours, and the patient may be up and about in two or three days The after-treatment should include all of the general hygienic measures suitable for patients with tuberculosis" See Fig 266

As regards the testicle, I would add that in suspicious cases I am in accord with Lapeyre ⁶⁹ that an exploratory orchidotomy, partial or complete, is not only justifiable but harmless

In the previous edition of this book (1924) I said that sinuses at the point of division of the vas deferens did not occur and that those of the scrotum are insignificant and infrequent Now, in 1936, I can repeat

this statement in absolute honesty and with all the conviction that the elapse of time and added experience will allow. I believe that the reason for this lack of annoying and often protracted complications is that the operation just described is based upon sound principles both of pathology and of surgery. (certainly an experience with it of several hundred epididymectomies enables me to make this statement in perfect safety)

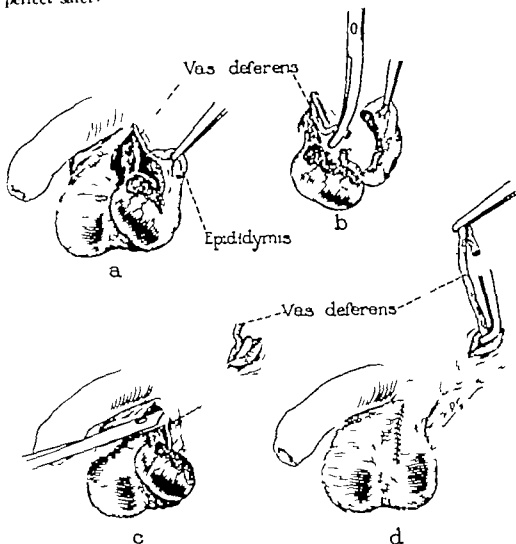


FIG. 256. Epididymovasectomy. Dissection of epididymis from testis. b. Freeing of epididymis and division of vas in mid-scrutum. c. Passing of vas up along inguinal canal to level of internal ring. d. Further freeing of vas over pelvic brim and clamping it.

Before this technique was used many surgeons reported the frequency with which fistula occurred at the stump of the divided vas. In fact it was for long the custom to attach this stump to the skin at the top of the scrotum at about the level of the external inguinal ring in order to provide for drainage of the remainder of the vas and of the corresponding seminal vesicle. In an effort to hasten the closure of these draining stumps and to cause cicatrization of the vesicle

Cunningham³⁰ advocated the injection of the stump of the vas with crude carbohc acid. For the technique of this procedure the reader is advised to consult the original article. Cunningham says that "the reaction from this method of treatment while severe in some cases is slight or absent in others, and whatever immediate discomfort there may be is of only passing interest if we can free the genital tract of so severe a disease

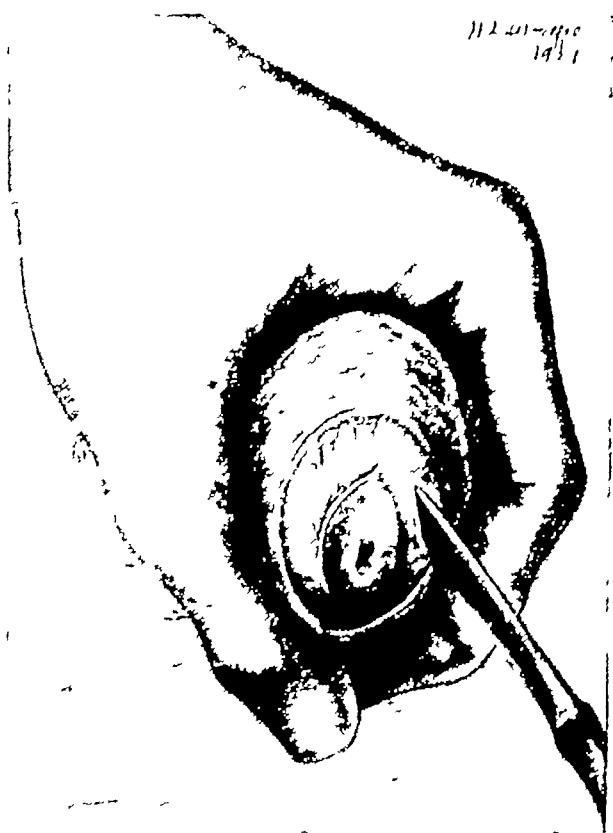


FIG. 267.—Scrotum grasped from above. Elliptical cut about the tuberculous sinus, subcutaneous tissue being divided by light concentric cuts. (The cuts illustrating this operation are taken from Cecil's article on "Extrusion Operation for Tuberculosis of the Epididymis," *J. Urol.*, February, 1935.)

"The examination of the vesicles and prostate months following operation usually shows the vesicles to be small, fibrous bodies, if palpable at all, and the prostate quite normal but often sclerotic, the material expressed by massage is small in amount. In no instance has the massage fluid following operation shown the tubercle bacillus in smears and in no instance has a contracture taken place in the urethral canal."

Cecil,^{24, 25} in 1930 and again in 1935, has described an operation for epididymectomy, with or without orchidectomy, which he claims is far superior to others. It will be seen that the description of it, which I here quote, and the illustrations of the various steps are very similar to that described by Cabot and myself and which has just been quoted

The main difference is that Cecil advocates a perpetuation of the old custom of attaching the stump of the vas to the skin. I do not see the logic of it nor do I feel that it is sound in principle. Cecil states that he has used this operation in 18 cases and that no sinus has yet occurred. But he also states that practically all of the cases have healed per primam.

The stages of Cecil's operation are as follows:

Any tuberculous sinuses are painted with pure carbolic acid, after the scrotum has been cleaned up. Next the scrotum is seized as shown in Figure 267 and gentle pressure is made above the testicle. An elliptical incision is then made through the skin around the sinus. Now while the pressure above the testicle is still maintained with the hand very light elliptical cuts are made concentrically dividing bands of tissue directly down to the tunica vaginalis. These concentric cuts are kept close around the elliptical skin incision. It will be seen that if the cuts are kept close to the central portion of skin a thick scrotal wall will be maintained also the opening of any abscesses may be avoided as these can be seen and the tissues can then be cut lightly further out. As the cuts are made the testicle and epididymis begin to extrude from the scrotum at the same time one can easily see and ligate every bleeding point. This is important to insure a dry scrotal bed to which to return the testicle.

In this manner the testicle is extruded through the wound rather than delivered as is done when the so-called high incision is made and trauma is avoided. The scrotum which has not been in any way contaminated is immediately wrapped with salt packs covered with a towel and kept absolutely surgically clean. Packs under the testicle complete the preparations for epididymectomy. The tunica vaginalis is opened and the epididymis is separated from the testicle (Figs. 268 to 271). The epididymis and testicle are both wrapped in warm salt packs and set aside. A clamp is pushed up along the vas until it corresponds with the external ring (Fig. 272). A small nick is made over the tip of this clamp and another clamp is pushed down along the same path (Fig. 273). This clamp is used for clamping off the vas (Fig. 273). The vas is cut between two clamps thoroughly carbolized. The clamp and vas are then drawn upward to bring the vas out in the groin but at no time is the clamp removed from the vas, nor is the vas ligated as all such attempts are likely to infect the wound.

A single stitch is passed through the nick (Fig. 274). This stitch is then lightly tied about the vas. The clamp with the vas still fastened in it is wrapped in gauze and strapped to the abdomen (Fig. 274). The scrotum is pulled down over the testicle and closed by interrupted dermal sutures (Fig. 275). A dry dressing is used without collodion. The scrotum is supported with a binder.

In about seven or eight days the vas comes away at the level of the skin much as the umbilical cord shrivels and dies. In some instances the vas has seemed to keep up its blood supply and in these cases a

ligature has been lightly tied around the vas, at the skin level, thereby causing it to slough away

"Where sinus is not present it has been my custom to extrude the testicle through the lowermost portion of the scrotum so that after the testicle is extruded, the scrotum is pushed back like a cuff, and at the

FIG 268

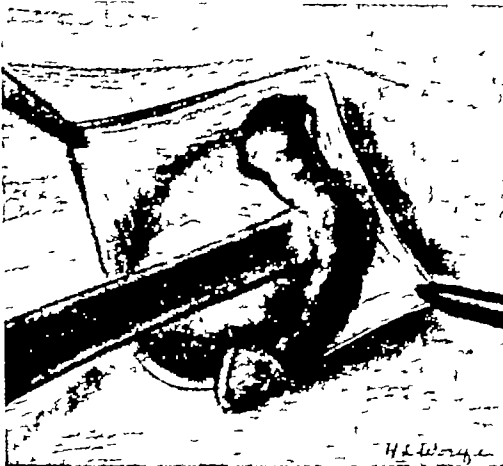


FIG 269

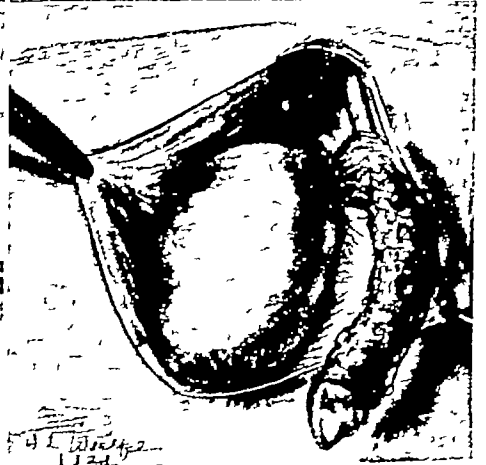
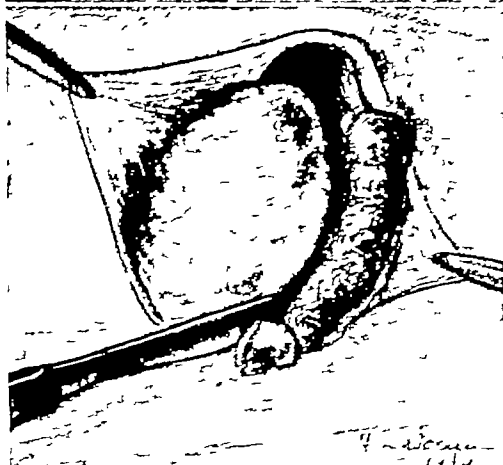
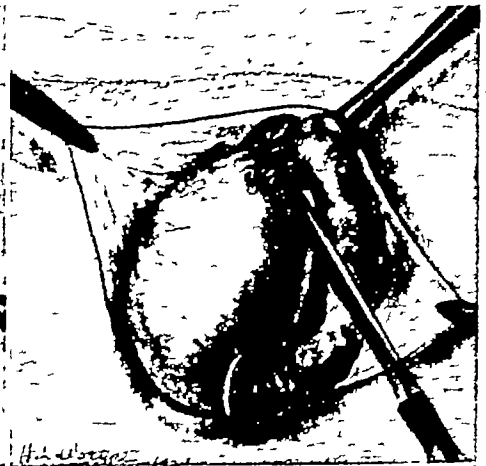


FIG 270

FIG 271

FIG 268 — Testicle entirely removed from scrotum Scrotum covered by gauze
Tunica vaginalis opened Separation of mid-portion of epididymis

FIG 269 — Globus major being separated from testicle by sharp dissection

FIG 270 — Separation of globus minor

FIG 271 — Epididymis entirely separated from testicle

completion of the operation of epididymectomy the cuff is pulled down over the testicle "

Our attitude toward the second epididymis, even though it be healthy, should be carefully considered I said in 1911,⁵ "Knowing the life history of the disease, and finding the patient already sterile, as we shall in a very large number of cases, we feel justified in advocating the removal of both epididymes and vasa at one sitting "

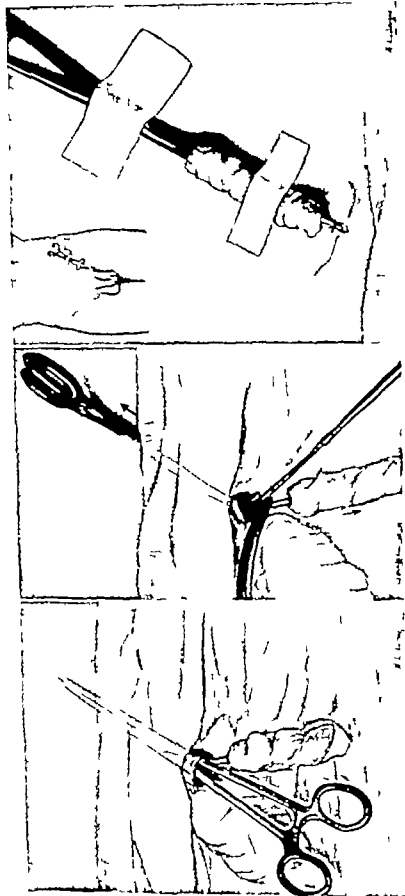


FIG 270

FIG 271

FIG 272

FIG 270 — Testicle and epididymis both wrapped in gauze. Clamp pushed up along the vas. Incision over tip of clamp.
 FIG 271 — Clamp passed down through small incision in groin. Vas divided and cauterized. Epididymis removed.
 FIG 272 — Vas pushed up through incision in groin. Clamp and vas wrapped in gauze and sutured to skin. Vas sutured to stab wound.

While this may appear to be a radical policy, it rests upon a firm basis of surgical pathology. The beneficial effects of double section of the vas, upon vesicular and prostatic lesions has been shown by Lapeyre⁶⁹ and Israel.⁶⁹

According to Legueu,⁶⁹ "In the presence of bilateral vesicular disease the second vas should be systematically ligated in the course of a unilateral operation. We then avoid at once the infection of the healthy testicle and serious involvement of the prostate." Lapeyre,⁶⁹ on the other hand, takes the more radical view. He has resected the healthy vas for three years as a routine practice and says that "after double section of the vas, as after double castration, the cure of vesiculoprostatis is more frequent than after a unilateral operation." If it is proved that the patient is already sterile, I regard this procedure as desirable. After considerable additional experience and observation I still regard these remarks to be sound. I find that Cecil,²⁵ the most

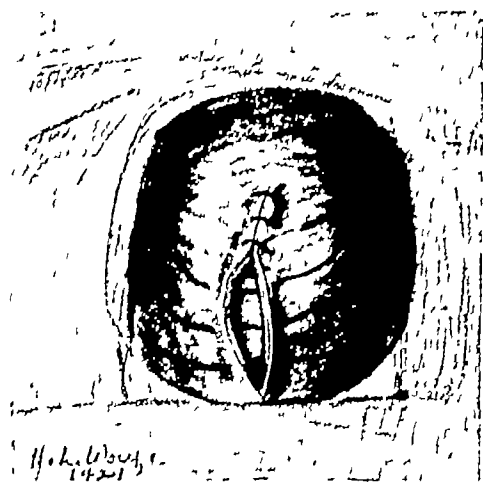


FIG. 275 -- Closure of scrotum by through-and-through dermal suture without drainage.

recent writer to discuss the subject, agrees with the position taken by me and by the other authors whom I have cited.

Before closing these remarks on the subject of conservative treatment, I might add that it is felt by some that an anastomosis between vas and testicle after epididymectomy can be carried out. Alberti,¹ in 1932, and Romani,⁹⁴ in 1931, have discussed the subject and reported cases. While there is no particular difficulty and possibly no harm in trying this experiment, and while in certain cases its success might mean a good deal to the patient from a sociological standpoint, the chances for a happy outcome are exceedingly small. We have seen that a great many patients with genital tuberculosis, even with only unilateral involvement, are already sterile, not only this but in the performance of such an anastomosis there would have to be present a considerable length of that portion of the vas which experience shows is definitely diseased.

Radical treatment involves the removal not only of the epididymis but also of the prostate and seminal vesicles in short ablation of the entire seminal tract. As yet I have seen no case where I thought this operation was necessary or wise and therefore have had no personal experience with it.

European surgeons have however been partial to the radical operation. Ullman⁴² in 1889 performed epididymovesiculectomy but the operation met with little favor on account of its dangers and difficulties. Baudet⁴³ popularized it by making use of the inguinal route. In his hands the mortality was practically nil and he reported 46 cures out of 58 after the elapse of from four to six years.

Interference with the tuberculous prostate either alone or in conjunction with the other genital organs seems to be generally regarded as a serious matter often leading to bad results. Incision and drainage gives only temporary relief and is generally productive of a permanent fistula. I agree with Lapevre⁴⁴ that operations upon the prostate are inadvisable mild affections will heal after the removal of the epididymis extensive lesions had best be left alone. In my opinion the same may be said of the seminal vesicle.

Among those who advocate the radical operation Young is not only the pioneer but even today its most enthusiastic champion. In 1900 he devised an extraperitoneal retrovesical suprapubic method of removing the seminal vesicles and the epididymis. In the words of Young "The results were not good and postoperative military tuberculosis occurred."

In 1918⁴⁵ he presented the more extensive but technically superior operation via the perineal route which with only minor changes he advocates today.

Meantime Whiteside⁴⁶ in 1910 took up the radical operation but with as we have seen unsatisfactory or indifferent results.

Quimby⁴⁷ in 1918 using Young's technique reported a small group of cases with no operative deaths and with excellent immediate results.

In 1928 Hinman⁴⁸ reviewed the subject of genital tuberculosis in a remarkably able and broadminded manner. He believes that there is a certain group of cases in which the radical operation is indicated rather than more conservative measures, and reported 13 in which he had carried out the radical operation. Hinman states that 2 are dead both being poor surgical risks 2 have not been traced and 9 are living and well. The results in these 9 patients have been satisfactory except for a perineal sinus which persisted for months to a few years in cases in which partial prostatectomy was performed.

The description of Young's⁴⁹ operation published in 1918 is given in his own language. The illustrations used Fig. 276 to 281 published by Young in 1935 *Jour Am Med Assn* illustrate sufficiently well the essential steps of the operation.

The ordinary inverted V-shaped perineal incision has been found entirely satisfactory and after division of the central tendon and recto-urethralis muscle the membranous urethra and apex of the pros-

tate are easily exposed without cutting the levator ani muscles. Up to this point the tractor has been introduced only sufficiently far so that its beak lies in the membranous urethra, thus giving an index as to its location. It is then carried into the bladder, opened out, traction made and pressure employed, thus by leverage forcing the prostate and seminal vesicles up into the wound where little difficulty is experienced in uncovering the fascia of Dénonvillier, the anterior layer of which forms the covering of and index to the seminal vesicles and vasa deferentia as well as the prostate. In this exposure the levator ani muscle is drawn outward and backward with the rectum exposing the superficial or posterior layer of Dénonvillier's fascia, which is divided near the apex of the prostate, thus uncovering the shining anterior or deep layer of Dénonvillier's fascia. The incision which must now

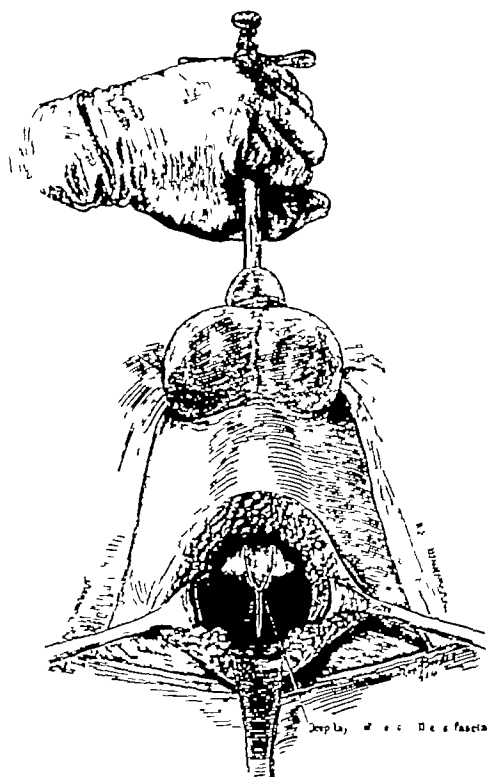


FIG 276

FIG 276 — The posterior layer of Dénonvillier's fascia has been pushed backward with the rectum, exposing the anterior layer of Dénonvillier's fascia covering prostate and seminal vesicles. Y-shaped incision through capsule is shown. (The cuts illustrating this operation are taken from Young's article on "Tuberculosis of the Genital Tract," J Am Med Assn, March 2, 1935.)

FIG 277 — Dénonvillier's fascia dissected up from the lateral lobes of the prostate and seminal vesicles.

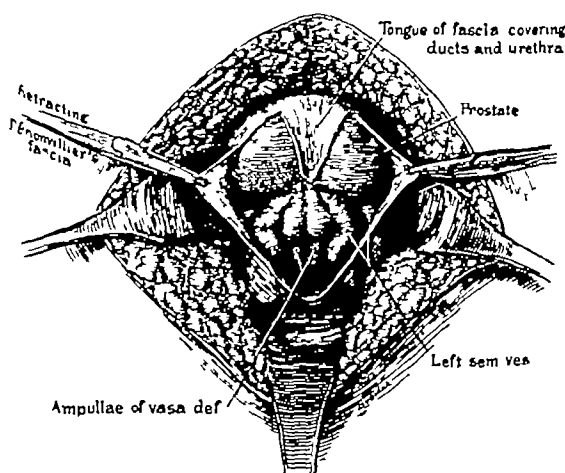


FIG 277

be made through the fascia of Dénonvillier in order to expose the vasa and seminal vesicles may vary somewhat according to the extent and character of the involvement, but as a rule a Y-shaped incision has been found most satisfactory.

The fascia is then elevated on both sides, thus exposing the lateral lobes of the prostate, ampulla, and seminal vesicles, and leaving the central portion of the prostate immediately beneath the urethra (in which the ejaculatory ducts lie) intact and covered by fascia which aids in protecting them. An excellent exposure is thus obtained and it is possible to determine exactly how

much should be removed whether the disease is unilateral or bilateral and whether one or both lobes of the prostate shall be excised. Another advantage of this method is that the main blood supply which lies externally is thus drawn outward with the fascia and hemorrhage is avoided making it possible to see well and to carry out a delicate and accurate blunt dissection without injury of the bladder to which the ampullæ and vesicles are often very adherent. The vas deferens should be freed well up toward the point where it winds around the ureter and then deeply clamped and divided the upper clamp being left attached to assist in removal of the upper portion of the vas deferens in case epididymectomy or castration is contemplated. The seminal

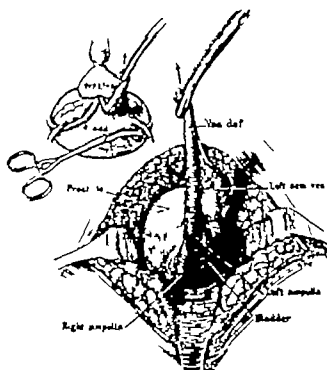


FIG. 278.—The left seminal vesicle has been freed after its pedicle has been clamped, ligated and divided. The vas divided high up is clamped and drawn downward. The right vesicle is freed and drawn down in the same way.

vesicle on this side is then freed firm adhesions being clamped and ligated after division in order to prevent bleeding and working from above downward the seminal vesicle and ampulla are freed until the juncture with the upper portion of the prostate is reached. If it seems desirable to remove a portion of the prostate, an incision is made parallel to and at a distance of 5 millimeters from the urethra (and dividing the ejaculatory duct) but leaving sufficient tissue to avoid a urinary fistula. After this the prostatic tissue is easily removed by enucleation from within its capsule and the fascia ampulla seminal vesicles and lateral lobe of the prostate are thus removed in one piece as shown in the illustration. If the disease is bilateral the same procedure is carried out on the opposite side and the wound then partly

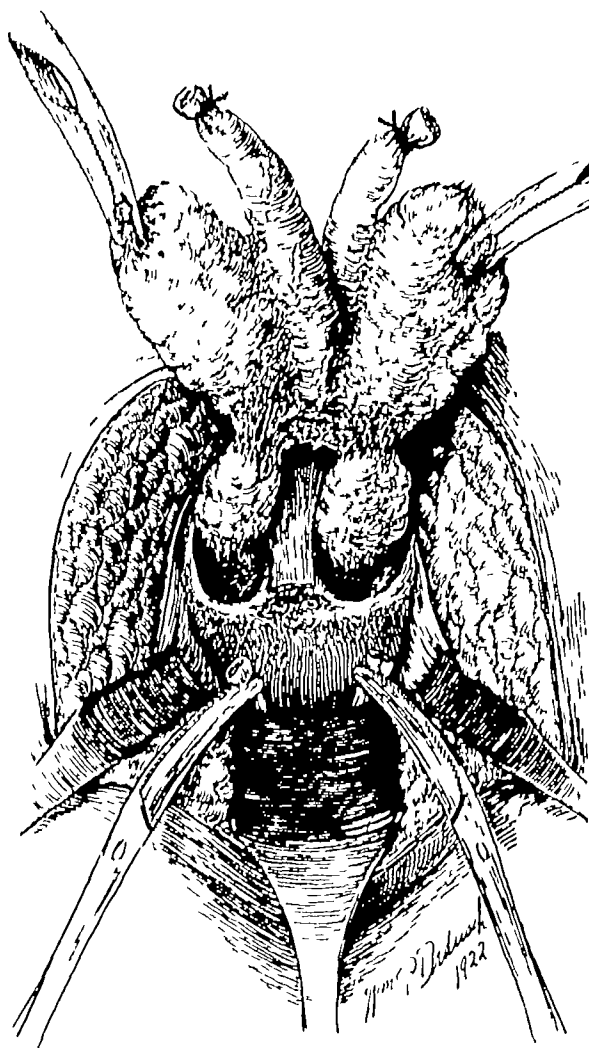


FIG. 279 —The seminal vesicles, ampullae and lateral lobes of the prostate have been freed from the bladder and urethra, which remain intact. The vas deferentia are still held by clamps.

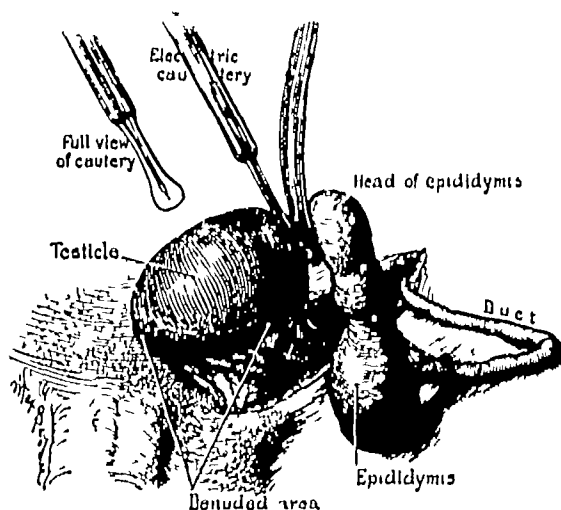


FIG. 280 —The tuberculous epididymis is being cut off from the testicle by the cautery, after which the testicle is returned to the scrotum.

closed the long clamps being left attached to the upper ends of the vasa deferentia for traction later. In this closure two iodoformized gauze drains are provided the levator ani muscles are brought together and the wound closed as in prostatectomy, leaving room for drainage. The patient is then placed on his back and epididymectomy or castration carried out according to the extent of the lesion present.

After careful hemostasis, testicles and veins are dropped back into the scrotum and the vas deferens which has been exposed up to the external ring is then freed from adhesions in its canal by a to-and-fro traction produced by an assistant pulling upon the clamp (which we mentioned above as being left upon the lower end of the vas deferens) alternating with traction by the operator upon the vas deferens in the groin. In

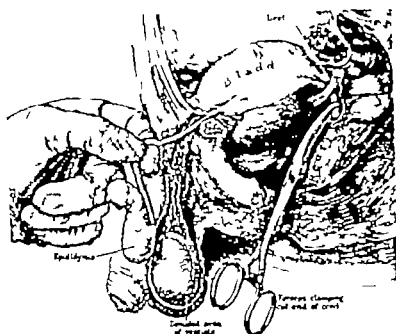


FIG. 2b1.—Method of traction (alt. resting between operator in groin and assistant pulling on clamp in perineal wound on vas) by which vas is freed and then drawn out through inguinal canal.

this way the vas is quickly freed and the assistant having liberated the vas from the clamp the vas is easily drawn out in its entirety through the groin. In this way we have a complete and radical removal of the entire seminal tract with the exception of a few millimeters the terminal portion of the ejaculatory duct and we have also a conservative prostatectomy leaving the urethra and bladder intact. This procedure which is far more thorough and radical than any other which has been proposed is carried out with great ease and is entirely under visual control.

A few additional comments as to the sequela of this operation may be added these being quoted from Young's^{1st} paper of 1922.

Perineal urinary fistula that supposedly great bugbear of operations on the tuberculous prostate and vesicles is present in only 1 case and

in this, only a few drops of urine escape during urination, so that the condition is not serious. Discharging sinuses are present either in the scrotum, groin or perineal wound in 6 cases. They are not really annoying, and compare favorably with statistics following epididymectomy (or castration) in which a much higher percentage of, and more annoying discharging sinuses are recorded in the literature.

The reader is here referred to my statement as to the results of the conservative operation.

Continuing, Young says, "Another most interesting demonstration is the fact that the sexual powers are not usually impaired in any way except that the amount of ejaculatory fluid is much lessened."

Just a word about the tuberculous stricture of the urethra. The treatment of this should, I am sure, be conservative. Gradual dilatation, under local anesthesia, is usually successful, but must be repeated at more or less regular and frequent intervals. In other cases internal urethrotomy may be necessary, but I believe this should be limited strictly to those strictures occurring in the anterior urethra. External urethrotomy is pretty certainly sure to result in a permanent urethral fistula.

In closing this review of the subject of genital tuberculosis a few points may be stressed.

1. There are two schools of thought as to the origin of the lesion. After being at variance for many years they still show no signs of agreement. A long contact with the subject, both clinically and through the literature, convinces me, however, that as time has gone on, with its accumulation of pathological evidence, there is beginning to develop a small but definite bit of common ground on which the contestants may stand. Just how rapidly or to what extent this ground will grow will depend entirely upon the amount of patient, long-continued investigation, both of the living and of the dead, which is carried out.

2. There is no doubt in my mind but that in time the difficult and elusive problem which has been the subject of this communication will be solved. Then, but not until then, can there be any actual agreement as to the rational surgical treatment to be used. Even now I believe that while the vast majority of cases are adequately treated by conservative surgery, there may be cases here and there in which the radical operation might be indicated. I feel sure that some of the radical surgeons feel equally open minded.

But in the present state of our knowledge and advancement in surgical technique several things must be considered. Most important of all is the question as to the ability of the surgeon to carry out the steps of so complicated and extensive an operation. Braasch's¹⁹ warning is timely when he suggests "that the average urological or genital surgeon can do as well (as Young) is decidedly open to question." Furthermore one must hesitate to advise an operation that even in the most skilful hands has an immediate and late mortality.

as high as is shown by Dr Young's figures. The burden of proof still rests with Dr Young in showing that the late mortality following complete removal of the genitalia is any better than when left alone.

3 Let none of us forget regardless of our opinion as to the origin of genital tuberculosis or as to the best method of treatment that the patient also has tuberculosis elsewhere in either a latent or active form. With this in mind one must not be surprised if the patient suddenly or eventually develops either a fresh outbreak of the disease or some one of its terminal forms. The evil day may be postponed or possibly eliminated by the careful administration of the various forms of palliative treatment which have been enumerated.

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In addition to the references cited above the author has consulted many other articles and has gained from them some idea as to the trend of thought on the part of many investigators. He acknowledges with gratitude the great help which he has received from a perusal of the "Review of Urologic Surgery" so ably handled by Dr. A. J. Scholl. He wishes also to acknowledge herewith his gratitude to Doctors Henry L. Sanford, Arthur B. Cecil and Hugh H. Young for their permission to use the cuts illustrating their respective articles. He wishes furthermore to acknowledge his gratitude to the editors of the publications in which these articles appeared.

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Incidence and Etiology—Tumors of the testis are rare. The frequency among male admissions in general hospitals is about 1 to 2000 (Tanner 1922). There have been about 5000 male admissions since 1907 in the University of California Hospital and about 8000 in the San Francisco City and County Hospital since 1919, a total of 13000. Among these were 32 men with proved tumor of the testis, an incidence of 1 to 1000. The unreliability of statistics which have not been carefully checked is shown by the fact that the records in both of the hospitals frequently gave wrongly the diagnosis of tumor. Many were purely clinical diagnoses. For example, at the San Francisco Hospital in 3 cases of castration for supposed tumor, subsequent pathological examination proved 1 to be gumma and 2 to be massive tuberculosis. In another case in which a diagnosis of tumor had been made and a course of irradiation given, gumma was proved later. Statistics collected from the indexes in general hospitals, which is the common method, obviously are inaccurate, and the frequency of tumor of the testis among male admissions is probably less than 0.003 per cent, which is the average of several such analyses (Howard Feeles, Bulkley, Tanner).

The relative frequency of testicular tumor in malignant tumors of all kinds is about 0.57 per cent (Curt, Corner, Slye). The right side seems to be slightly more often involved than the left (123 to 99 times) and over 24 instances of bilateral involvement, mostly in cryptorchids, have been reported.

The relative frequency of tumor in undescended testes is hard to estimate. Statistics show it to be about 0.17 per cent (Feeles, Coley, Kocher, Brenner, Hofstatter, Coaritz, Mackenzie and Ratner). Thus of 728 testicular tumors variously reported, 82, or 11.2 per cent, were in undescended testes. On the other hand, among 3646 cases of undescended testis variously collected, there were only 8 instances of malignancy. Up to October, 1934, a total of 136 tumors occurring in undescended testicles had been reported (Mackenzie and Ratner). The relative frequency of cryptorchidism has been variously estimated, and it should be kept in mind in this connection that the incidence in boys will be higher than in men [1 to 300 (medical records of the World War), 1 to 600 (Renner), 1 to 1000 (Marshall)].

According to these statistics, about 1 patient in every 2000 male admissions to general hospitals has teratoma. About 4 (1 to 100) of these 2000 will be cryptorchids, and tumor occurs about once in every 100 cryptorchids (8 in 3646 cases), which is a higher incidence than is found in the normally placed gland. On this ratio, 1 of about every 20 teratomata will be in an undescended testis. Various statistics give the incidence as high as 1 in 9 (82 tumors of undescended testes in 728 testicular tumors, or 11.2 per cent, Howard, Chevassu, Odierne and Simmons, Coley, Kober, Von Kahlen, Uffreduzzi, Mackenzie and Ratner, and Hinman).

The importance of statistics of this kind rests on their value in determining whether abdominal and inguinal retention predispose the testicle

CHAPTER XV

TUMORS OF THE TESTICLE

BY FRANK HINMAN, M D , F A C S

Introduction.—The subject of tumors of the testicle gains in interest by recent developments of two kinds, one in diagnosis and the other in treatment. The discovery that many of these tumors cause the excretion of a gonadotropic hormone in the urine similar to that found in the urine of pregnant women is of practical use in diagnosis and prognosis. The perfection of powerful roentgen equipment and the consequent use of more penetrating, more intensive therapeutic irradiation is changing the plan of management, with some improvement in the outlook of these patients.

The dispute over pathogenesis, however, remains unchanged and confusion persists in the classification of testicular new growths. Many pathologists are frank to admit that at present some of these tumors cannot be classified. There is no accepted standard of classification. Every pathologist has his own scheme of division and nomenclature. It follows, therefore, that the dispute as to treatment is still active. Perhaps in the near future the correlation of structure with the results of the hormonal test and of irradiation (as to sensitivity and resistance) will tend to settle many questions of pathogenesis and of treatment which are now in dispute. At present these facts are too few to be of much value. Tumors of the testicle are rare and no one person has had an opportunity to study a large series. A fair comparison of the reports from many different sources, which would give a large series for analysis, is impossible because of the differences of view and nomenclature just mentioned.

The parts of the subject particularly controversial and active at present are the microscopic interpretation of the various pathological changes and their classification on this basis into separate groups, and the relation of each of these distinct pathological entities, first, to the presence and the amount of a gonadotropic hormone in the urine and, second, to the sensitivity of the growth, in part or as a whole, to irradiation. Some tumors form no hormone at all, others a small amount and still others an enormous amount. Some tumors are very sensitive to irradiation and therefore curable, others are radiosensitive but not curable and still others are highly resistant and can be cured only by complete surgical removal.

This brief discussion indicates the transitional state of the subject and the following presentation will attempt to give the facts of this transition.

Incidence and Etiology—Tumors of the testis are rare. The frequency among male admissions in general hospitals is about 1 to 2000 (Tanner 1922). There have been about 5000 male admissions since 1907 in the University of California Hospital and about 5000 in the San Francisco City and County Hospital since 1919, a total of 8000. Among these were 32 men with proved tumor of the testis, an incidence of 1 to 1600. The unreliability of statistics which have not been carefully checked is shown by the fact that the records in both of the hospitals frequently gave wrongly the diagnosis of tumor. Many were purely clinical diagnoses. For example at the San Francisco Hospital in 3 cases of castration for supposed tumor subsequent pathological examination proved 3 to be gumma and 2 to be massive tuberculosis. In another case in which a diagnosis of tumor had been made and a course of irradiation given, gumma was proved later. Statistics collected from the indexes in general hospitals, which is the common method, obviously are inaccurate and the frequency of tumor of the testis among male admissions is probably less than 0.063 per cent, which is the average of several such analyses (Howard, Eccles, Bulkley, Tanner).

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The purpose of this book is to present a summary of the subject of testicular tumors, and to discuss the various pathological changes and their classification on this basis into separate groups, and the relation of each of these distinct pathological entities, first, to the presence and the amount of a gonadotropic hormone in the urine and, second, to the sensitivity of the growth, in part or as a whole, to irradiation. Some tumors form no hormone at all, others a small amount and still others an enormous amount. Some tumors are very sensitive to irradiation and therefore curable; some are insensitive but not curable and still others are highly sensitive and are cured only by complete surgical removal.

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to malignant changes At present this point remains unsolved The abdominal testis is not exposed to injury as the inguinal or scrotal testis is Whether tumor is relatively more frequent with inguinal than abdominal retention is uncertain Certainly the view that the undescended testis should be removed if orchiopexy is not possible, because of the risk of its becoming malignant, is too radical, although this argument is valid when advising orchiopexy The rôle of trauma in the etiology, in any case, is uncertain That a chronic irritation incidental to the loss of spermatogenesis will prove an etiological factor is doubtful This is true also of single injuries to the inguinal and normally placed organs, which probably do no more than call attention or act as a stimulus to an already existing growth

The cause of testicular tumor is unknown

Pathological Changes — Anyone who will take the time to look over a series of slides of tumors of the testicle will recognize the impossibility of reconciling, by microscopic study alone, the divergent views of pathogenesis There are three main points of origin for tumors of the testicle They can arise from totipotent sex cells which may be primordial germ cells or differentiated somatic cells, from a fetal remnant or isolated blastomere, or from an adult tissue cell of the testicle If it arises from the first, the growth would be embryonal, a mixed tumor and malignant, if from the second, a congenital and benign dermoid or an adult teratoma which may show malignant changes, and, if from the third, a type of tumor characteristic of the cell from which it originated which might be connective tissue or epithelium and either benign or malignant (Fig 282) Some confusion arises from designating as teratomata the two different types of tumor which arise from totipotent cells and from fetal remnants, even though it is customary to term the former "embryonal" teratoma and the latter "adult" teratoma Adult teratomata are usually benign, however, they may undergo malignant changes and give the microscopic picture of a carcinoma This type of tumor is entirely different from the embryonal tumors and occurs much more frequently elsewhere in the body than in the testicle

The question of genesis gains more than theoretical interest from the fact that, of all tumors, embryonal teratomata are the only ones forming a gonadotropic hormone Most pathologists favor the origin of these tumors from primitive sexual cells whose normal development into spermatogonia has been suppressed To quote some of these expert opinions

"It has been known for some time that in the development of the ovum the process of segmentation leads shortly to the special separation of many germinal or primitive sex cells Some of these become marooned If such cells at any stage in their wandering could be fertilized or stirred to development without fertilization, they would offer a satisfactory explanation for the growth of such complicated masses as the teratomata Such tumors are like a pregnancy and could not be explained as the outgrowth of a somatic

blastomere. Indeed it seems to me that there are two very distinct classes of teratoma of which one class appears to spring from the stimulation to development of a primitive sex cell the other from the inclusion of a somatic blastomere (MacCallum)

Regarding the causal genesis of teratomas there are few data. The isolation of blastomeres is not known to occur much less the causes of such isolation. For the teratomas of sex glands there is much clinical evidence that trauma figures in many cases and excites the parthenogenetic development of the aberrant sex cell. Three main groups containing adult or embryonal organs in disorderly arrangement occur

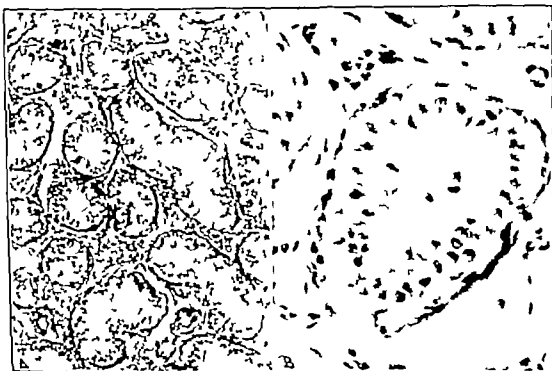


FIG. 28. —Photomicrographs of the normal seminiferous tubules, *A* low power *B* high power taken at the same magnification as the photomicrographs of the testicular tumors which follow in order to illustrate the relative sizes of the cells.

- 1 Teratomas from aberrant sex cells (chiefly in sex glands)
 - 2 Extragenital teratomas—from isolated blastomeres.
 - 3 Teratomas (or teratoids) derived from multipotent material of distinct regional stamp and reproducing the organs of these regions.
- The chief source of teratomas is probably the aberrant sex cell. This origin alone adequately accounts for the predilection of teratomas for the sex glands (Ewing)

It seems rational to apply to these tumors [chorioneplithelioma] the theory proposed by Adam (1910) to explain the origin of ovarian and testicular teratomata. This modified parthenogenic or germ-cell theory attributes the tumors to aberrant development of the spermatogonia or oögonia (or possibly their precursors) but not to the spermatozoa or

ova themselves. It is known that certain cells—the germinal blastomeres, recognizable at an early stage of segmentation—are set apart and eventually carried to the generative glands where they later form ova or spermatozoa. All the intermediate stages of development between the primordial germinal blastomeres and the ova and spermatozoa retain the totipotential characteristics necessary for the formation of the three germinal layers of an embryo or an embryoma. Consequently a derivative from a germinal blastomere, normally present in the testicle, may take on aberrant characteristics and form a teratomatous or terablastomatous tumor, containing elements of fetal membranes. This hypothesis seems to meet all requirements” (Cooke)

“Beard’s thesis, then, would derive the seminiferous cells, not from the mesothelium covering the genital ridge, but from primitive sex cells which are budded off the morula and, passing to the genital area, become associated with the mesothelial ingrowths and mesoblastic tissue which provide merely support and nourishment. The

process of spermatogenesis, then, is as follows. The spermatogonia divide and produce the spermatocytes of the first order. These divide again, producing the spermatocytes of the second order, which in turn divide and produce the spermatids or future spermatozoa, the whole appearance closely resembling that of the early Graafian follicle with enclosed ovum.

If, however, we regard the testis in the same light as any other secreting gland, we should expect simple adenoma of the seminiferous tubules to appear with fair frequency in relation to the malignant adenoma or seminoma, but adenoma testis of this variety is rarely observed, though, like the small adenoma of the kidney, it may often escape detection. If by any chance the sex cells are stimulated to segment—and in the early stages of development no essential difference can be made out between the sex cells of the ovary and testis—*teratomatous tumours* may result, for these cells, the oogonia and spermatogonia, are regarded as totipotent and capable of giving rise to any or all of the tissues of the body” (Bell)

It may be said, therefore, that the majority of these tumors of the testis arise from primitive sexual cells in the region of the rete testis and are embryonal. Other types of tumors of the testis are relatively rare and a means of differentiation, when the microscopic findings are doubtful, is the hormonal test. Embryonal tumors alone secrete the gonadotropic hormone, a fact which supports the parthogenetic theory of the origin from primitive sexual cells.

Another point of confusion in the classification of these tumors arises from Ewing’s demonstration that many seemingly uniform tumors are the result of dominance of one type of cell in a mixed growth. Many apparent monocellular tumors, the so-called seminomata and sarcomata of the past, can be shown by careful study to be mixed tumors or embryonal teratomata. To prove or disprove this might require a detailed study of serial sections of the entire growth.

“It is important to pay attention to the periphery, and especially to the region of the upper pole of the specimen, for it is here that the

remains of the testis proper are so often encountered and the discovery of testicular tissue separated from the neoplastic tissue by a condensation of fibrous tissue is strongly presumptive evidence of a teratoid origin. It cannot be emphasized too strongly that the examination of a small piece of these complex tumours may be highly misleading. Again and again repeated sections have demonstrated the teratoid character in cases where the first section suggested a simple cellular tumour and furthermore the various blastodermic derivatives show an occasional tendency to be aggregated in one area and appear to dominate the histological picture in the absence of further examination.

A short account of the tissues commonly met with as depicted by the present group is given with the object of considering the possible relations of these tissues to the development of tumours by a process of individual overgrowth.

1 *Mezoblast* — The formed elements are represented by hyaline cartilage, bone, plain and striped muscle, fat, and lymphoid tissue.

Hyaline cartilage is the most frequent and striking derivative.

Bone is not a common feature.

Plain muscle is a common element.

Striped muscle has been a rare element.

Heart muscle is said to be excessively rare.

Lymphoid tissue is frequently present. It may have an irregular nodular distribution but is commonly seen in association with glandular spaces lying between the epithelial and muscular layers, and doubtless representing the lymphoid tissue of the digestive tract. It is also commonly observed in malignant cellular tumours forming a lymphoid stroma or network around the alveolar groups. It has been suggested that overgrowth of the lymphoid tissue of a teratoma may give origin to lymphosarcoma testis. This subject is discussed later but in the meantime the frequent presence of lymphoid structures in teratoid tumours should be noted.

2 *Gyphoblast* — This is represented by glandular tubules or spaces lined by cubical or columnar cells.

Digestive tubes are lined by columnar cells and the goblet or mucigenous type is the striking feature. Both small and large intestine may be represented.

Respiratory tubes are lined by columnar cells sometimes ciliated.

Certain glandular organs such as salivary glands, prostate, heart, liver and pancreas have all been described. Thyroid tissue was present in three specimens.

3 *Epiblast* — Stratified epithelium is the most frequent and striking representative but is sometimes scanty and hard to find and may be absent. (Bell)

In addition there is trophoblast from which is derived the chorion epitheliomata.

On the basis of microscopic study and with the reservation that all monocellular malignant tumors (unless they have been examined

serially) are possibly mixed tumors, the following classification is devised

I. HOMOLOGOUS TUMORS.

A *Benign*

1 Epithelial

(a) Adenoma of the seminal tubules

(b) Misplaced ectoderm

2 Mesoblastic

(a) Interstitial cell tumors (probably not true tumors but merely hyperplasia [Ewing]).

(b) Tumors of connective tissue

(c) Misplaced mesonephric tissue

B *Malignant*

1 Epithelial

(a) *Seminoma* or Spermatocytoma (a unicellular type of tumor derived from adult spermatogonia or spermatocytes)

2 Mesoblastic (lymphosarcoma, myosarcoma) sarcoma, very rare, and the few authentic cases reported as homologous tumors are regarded by many as representing a one-sided development of teratomata

3 Tumors of adrenal rests (small cell adenocarcinoma derived from adrenal tubules, occurring in men of middle age and running a slow course [Ewing, Bell, Stevens])

II HETEROLOGOUS TUMORS (teratomata or mixed tumors)

A *Benign*

1 Dermoid cysts (simple and complex)

2 Organized embryomata

B *Malignant*

1 Adult teratoma (with few or early malignant changes)

2 *Embryonal teratoma* (embryonal carcinoma, heterologous tissue may be present or may have been overgrown Occurs as complex varieties of fairly uniform to very mixed tumors)

Predominating type may be

(a) Hypoblastic (most common)

(1) Embryonal adenocarcinoma

(2) Embryonal spheroidal cell sarcoma

(3) Embryonal carcinoma with lymphoid stroma

(b) Mesoblastic

(1) Sarcomatous mixed tumor
(Carcinosarcoma of Bell)

(2) Myxochondro-endotheliomata

PLATE X



Mixed Tumor (Teratoma) of Left Testicle

Successfully removed (October 16, 1922) by radical operation from a man aged thirty-three years, together with unusually large metastatic lumbo-aortic glands. The onset of the tumor followed immediately upon severe trauma sustained ten months previously. The patient made an uneventful recovery following the operation and was discharged from the hospital in three weeks. Note the vacillated cystic structure of the cut surface characteristic of teratoma which usually enables one to distinguish it grossly from the smooth solid homogeneous structure of the unicellular "seminoma" (Courtesy of Dr. Hugh H. Young, Baltimore, Md.)

(c) Epiblastic (least common)

(1) Alveolar squamous- and basal-cell epitheliomata

(2) Neuro-epithelioma and neuroectoma

(d) Trophoblastic (rare)

(1) Chorionepithelioma

III TUMORS WHICH CANNOT BE CLASSIFIED AS ABOVE

It is seen that the seminoma (spermatocytoma or germinal-celled tumor) which according to Chevassu occurs from a proliferation of the cells of the seminiferous tubules in precisely the same way as glandular carcinoma of other organs (Bell) would not be expected to form a gonadotropic hormone. Whether this test will settle in time the controversy regarding these tumors of monocellular type is doubtful. They arise as a one-sided development of an embryonal tumor according to Ewing, and as mentioned previously might be sufficiently differentiated not to form a gonadotropic hormone or sufficiently embryonal to form the hormone only in small amounts. A microscopically typical seminoma (3 cases in Table 1) which fails to form the hormone therefore might have originated from primitive sex cells with subsequent differentiation or from adult fully differentiated sperm cells. However every microscopically typical so-called seminoma which gives a positive hormonal test must have arisen from primitive sexual cells and therefore is not a seminoma but an embryonal carcinoma.

Chevassu described lymphoid stroma as a characteristic of the seminoma and Ewing recognized embryonal carcinoma with and without lymphoid stroma. In the beginning the lymphocytes appear along the lines of the vessels in the scanty stroma and gradually accumulate and proliferate as the stroma and contained vessels disappear from the picture. Ultimately the lymphocytes come to form an interlacing network enclosing individual alveoli or groups of alveoli. This peculiar condition I think is best regarded as a connective-tissue reaction which seeks to confine the activities of the tumour cells—on the same lines, for example, as the round-celled barrier opposing the downward growth of the epithelial cells in a cancer of the lip or tongue. In addition to or apart from a scanty or abundant lymphoid stroma it is not uncommon to see nodules of lymph corpuscles scattered irregularly through the tumour tissue (Bell). Ferguson following Ewing's classification divided his patients all of whom excreted the hormone into four groups. Fifteen had embryonal carcinomata with lymphoid stroma, 10 had seminomata, 7 adenocarcinomata and 5 adult teratomata. The studies of the writer and Powell indicate that the true seminoma and the adult teratoma do not form a gonadotropic hormone (See Tables 1, 2 and 3.)

A recent microscopic study of my own material (in conjunction with my assistant, Powell and the pathologist, Carr) shows the uncertainty of interpretation and classification of some tumors without serial sections of all parts of them. This has not been done because of the

magnitude of such a procedure. However, by correlation of the microscopic picture with a quantitative estimation of the gonadotropic hormone in the urine (discussed under diagnosis), the foregoing rather elaborate classification may be very much simplified. If only those tumors derived from totipotent sex cells generate the hormone, and the congenital teratoids, the adult teratomata and the homologous tumors

TABLE 1—QUANTITATIVE HORMONIC EXCRETION

Type 1 Embryonal Tumors

Group A Embryonal Carcinoma

Before operation hormone, M U L		Before irradiation hormone, M U L	Immediately following operation (within 2 mos) hormone, M U L	Immediately following irradiation hormone, M U L	Clinical metastases when first seen, A C N	Time since operation or irradiation	Present condition
1	8,000	8,000	0	Subgroup 1 0	0	6 mos	No 3—85,000 (Reached 150,000)
2	1,000	0	X	X	0	1 mo	No 1
Subgroup 2							
1	X	1,000	X	100 (1 mos)	A (7 yrs)	9 yrs	No 2—600
2	X	1,000	1000	200	A	9 mos	?No 2—300
3	X	X	X	250	0 (C-250)	1 yr	Dead X
4	X	0	Radical	0	0	2 yrs	No 1
5	20,000	20,000	X	2000	A C	3 mos	Dead No 3
6	X	100	100	0	0	2 mos	No 1
7	X	1,000	X	500	A	1½ yrs	?Dead No 3
Subgroup 3							
1	X	X	X	X	0	10 yrs	No 1
2	500	500-50	50	10	0	1½ yrs	No 2 (1½ yrs) 600
3	X	X	300 (2½ yrs)	200-300 (2½ yrs)	0	3 yrs	No 3 (2½ yrs) 300
4	X	X	1 less than 100	1 less than 100	0	?	?No 2—300
5	X	X	X	1000 (1 yr)	0 (1 yr)	2 yrs	No 1
6	X	250	250	0	0	9 mos	No 1
7	250	250	0	750 (5 mos)	0	6 mos	No 1
8	500	1,000	X	1000	A	6 mos	Dead—1000
9	X	0	0	X	0	1 mo	No 1
10	X	X	100	100	0	1 yr	No 1
11	X	X	X	0	O-C	6 yrs	No 1
12	X	Later 500 350-100	350	X	0 (1 mo)	6 mos	No 2—500
13	X	1,000	1000	100-500 (3 mos)	0	1 yr	Dead—200
14	X	X	100	200	0	6 mos	No 1
15	X	X	X	No x-ray	0	1 yr	No 1
16	X	0	0	250	0	1 mo	No 3—100
17	X	0	Radical 0	0	0	2 yrs	No 1 ?No 2—350
18	X	X	X	X	0	3 yrs	No 3—500
19	X	X	X	3 yrs—500	A	1½ yrs	No 1—0
20	X	X	0-1 yr	0	0	1 yr	No 1
21	X	X	1000 (6 yrs)	1000 (6 yrs)	0	8 yrs	No 2—750
Subgroup 4 (Seminoma)							
1	X	0	0	0	A	?	No 3—0 *
2	0	0	0	X	0	2 mos	No 1 *
3	0	0	0	0	0	1 yr	No 1

Key M U L = mouse units per liter

No 1 = Patient free from metastases clinically and with no hormonal excretion

No 2 = Patient free from metastases clinically but has hormonal excretion in the urine

No 3 = Patient has metastases clinically with or without hormonal excretion in the urine

A = Abdominal metastases

C = Chest metastases

N = Virchow's node in the supraclavicular area

X = Hormonic tests not carried out

O = Hormonic test was carried out with negative results

* = The tumor tissue was extracted and found not to contain the gonadotropic hormone

do not cause it to be excreted this fact can be used to good purpose in the more exact classification of testicular tumors. For practical purposes only three types need be recognized from microscopic and hormone studies, namely:

- 1 Embryonal tumors.
 - a Embryonal carcinoma (53 personal cases)
 - b Embryonal teratoma (9 personal cases)
- 2 Adult teratoma (2 personal cases)
- 3 Miscellaneous tumors

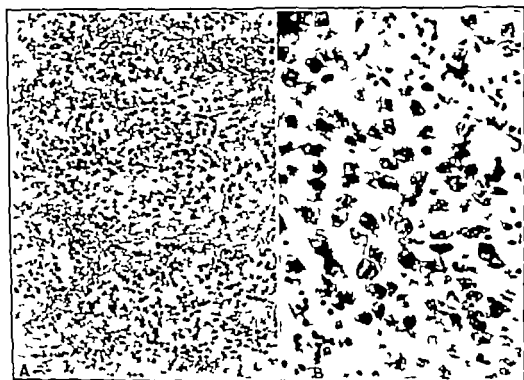


FIG. 283.—Photomicrograph of a monocellular type tumor formed of large vesicular cells resembling spermatocytes (Case 1 Subgroup 4). *A* low power *B* high power. Compare with Fig. 282. The gross appearance on section of a growth homogenous surface is shown in Fig. 294.

1 *The embryonal tumors* (90 to 9) per cent of all tumors of the testicle.) Hypoblastic mesoblastic epiblastic and trophoblastic varieties are recognizable. The most embryonal of this group are mixed-celled tumors an ontogenetic characteristic of primordial cells. There is considerable proof that the primordial cells from which these tumors arise are in fact sex cells. The most embryonal of these cells would not be expected to give rise to tumors which would differentiate into cells resembling or representing adult sex cells but would manifest more embryonal potencies and functions—namely a reproduction of the germ layers and secretion of the gonadotropic hormone. The more differentiated and least embryonal of these cells would be expected to give rise to unicellular tumors composed of cells resembling young sex cells (Fig. 283). Some of these monocellular tumors would be expected

to be sufficiently differentiated to fail to secrete a gonadotropic hormone (Whether they secrete the normal germinal cell hormone, inhibin, postulated and named by McCullagh, although highly possible, has not been confirmed)

In the series of 44 cases in which hormonal tests have been made, 33 have been grouped as embryonal carcinoma (Table 1) In two of these cases (Subgroup 1) there were very large primitive cells simulating chorionepithelioma except that syncytial cells were absent and there was a high output of the hormone in both of these patients. In 7 cases there were small cells with well marked lymphoid stroma (Subgroup 2) In the majority, 21 cases, there were larger cells with variable lymphoid stroma (Subgroup 3) (Most pathologists would classify these tumors as seminomata) The hormone was excreted at some time in all of these Three patients (Subgroup 4) had monocellular tumors with large cells typical of the seminoma and none of these at any time has shown the gonadotropic hormone in his urine (Fig 283)

TABLE 2 —QUANTITATIVE HORMONIC EXCRETION
Type 1 Embryonal Tumors
Group B Mixed Embryonal Teratomata

	Before operation hormone, M U L	Before irradiation hormone, M U L	Immediately following operation (within 2 mos) hormone, M U L	Immediately following irradiation hormone, M U L	Clinical metastases when first seen A C N	Time since operation or irradiation	Present condition
1	X	X	250	Subgroup 1 Quit treatment 750 350 (3 mos) X 1000 (2 yrs) 200 0	0	6 mos	No 1
2	X	2000	2000		X	5 mos	No 2—2000
3	X	X	X		X	3 yrs	No 1
4	500	500	200		A	6 mos	Dead—500
5	1000	1000	Castration and radical—0		Proven at radical op O—A	1½ yrs	No 3 (6 mos) 500 No 2 (1 yr) 400

All of the cases listed above are of the differentiated teratoid type, but all of these cases showed adenocarcinoma to be present also

				Subgroup 2 (Embryonal Adenocarcinoma)		
1	X	50,000	50,000	X	0	6 mos Dead—X 50,000 (2 mos earlier)
2	1000	X	X	X	?0	6 mos onset No 2 ?No 3
1	X	10,000	10,000	Subgroup 3 (Chorionepithelioma)	X	1 yr Dead—1,000,000
2	X	X	X 20,000 (6 mos later)		X	1½ yrs Dead—20,000

(See Table 1 for Key)

The tumors removed from 9 patients (Table 2) were grouped as mixed embryonal teratoma In 5 of these (Subgroup 1), many of the cells, although of many varieties, were primitive, but the tumors as a whole showed considerable differentiation and always showed areas of adenocarcinoma (Fig 284) The histological picture of adenocarcin-

oma predominated in 2 others grouped in consequence as embryonal adenocarcinoma (Subgroup 2) (Fig 285) Two patients had definite chorionepitheliomata (Subgroup 3) (Fig 286) (These tumors are similar microscopically to those occurring in women Spontaneous disappearance of these latter during pregnancy has been observed Systematic injections of the blood serum of a healthy woman from four to five months pregnant should be tried therapeutically in some of these testicular chorionepitheliomata to test the possibility that trophoblastic cells of the placenta generate a curative hormone)



FIG. 284.—Photomicrographs of an embryonal teratoma with groups of primitive cells but with areas of adenocarcinoma. A low power B high power the growth of which on section is shown in Fig 294

2 *Adult teratomata* (about 5 per cent of all tumors of the testis) These tumors, being fully differentiated would not be expected to secrete a gonadotropic hormone They form the dermoid cysts and organized embryomata types of tumor which occur more frequently elsewhere than in the testis They comprise the adult mixed tumors with fully differentiated cells of the testis (Fig 287) Two patients had tumors of this kind (Table 3) Neither excreted gonadotropic hormone at any time.

3 *Miscellaneous tumors* (from 1 to 2 per cent of tumors of the testis) These tumors are relatively rare and unimportant clinically Except for the rare sarcoma they are mostly benign (see classification) Whenever a tumor cannot be classified microscopically, a positive hormone test demonstrates its embryonal character and places it in the

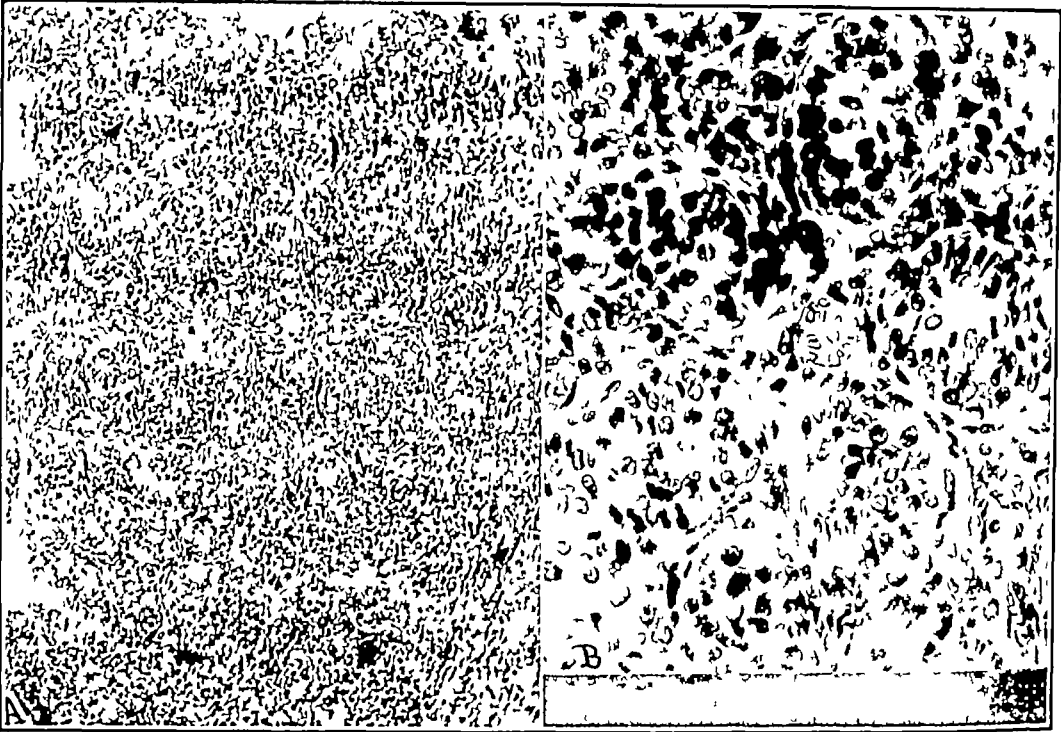


FIG 285 —Photomicrograph of an embryonal adenocarcinoma, *A*, low power, *B*, high power

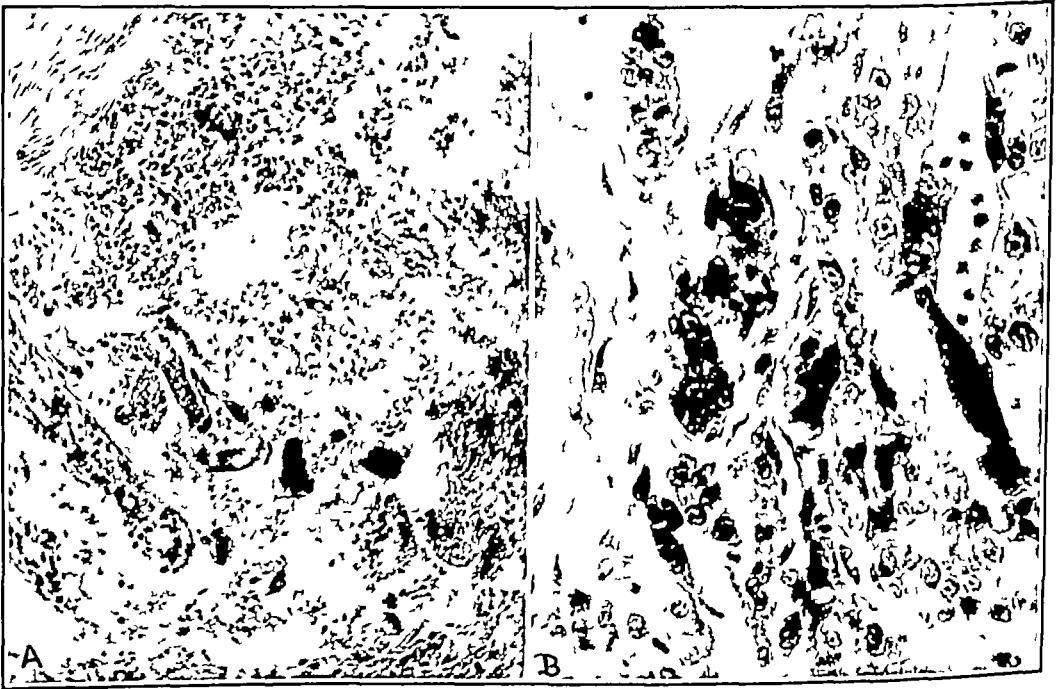


FIG 286 —Photomicrograph of a chorionepithelioma showing large syncytial cells taken from a metastasis in the lung — *A*, low power *B*, high power The gross appearance of this tumor on section is shown in Fig 294



FIG. 257.—Photomicrograph of an adult teratoma.

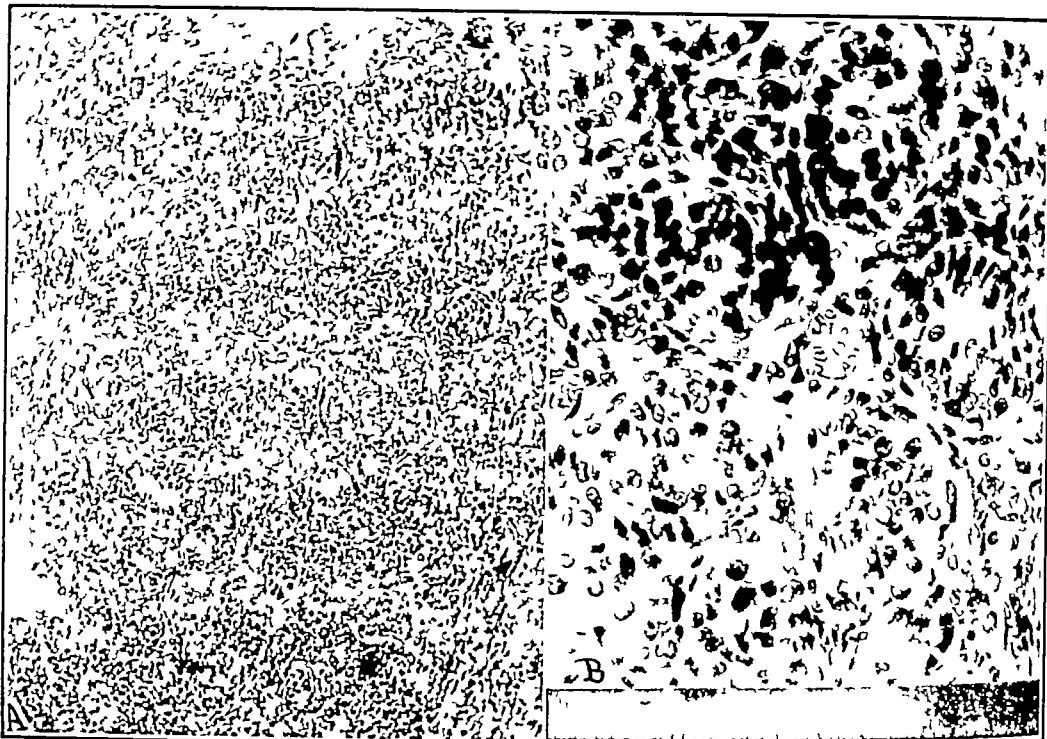


FIG. 285 —Photomicrograph of an embryonal adenocarcinoma, *A*, low power, *B*, high power

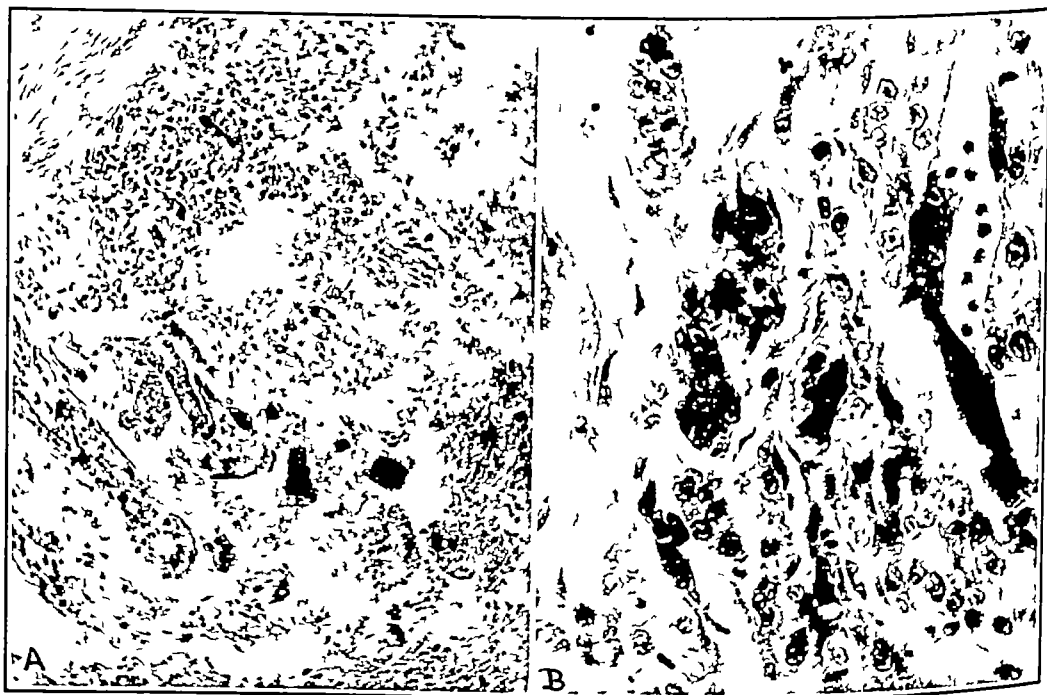


FIG. 286 —Photomicrograph of a chorionepithelioma showing large syncytial cells taken from a metastasis in the lung. *A*, low power, *B*, high power. The gross appearance of this tumor on section is shown in Fig. 294



FIG. 4. — Photomicrographs of an adult teratoma.

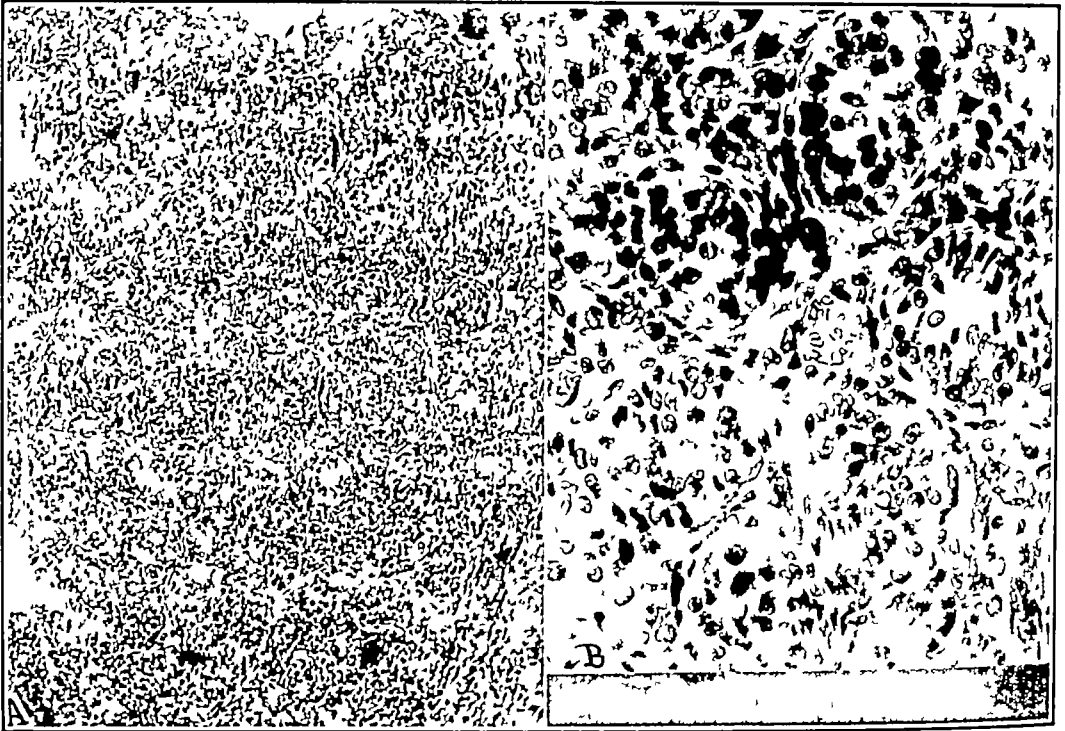


FIG 285 —Photomicrograph of an embryonal adenocarcinoma, *A*, low power, *B*, high power

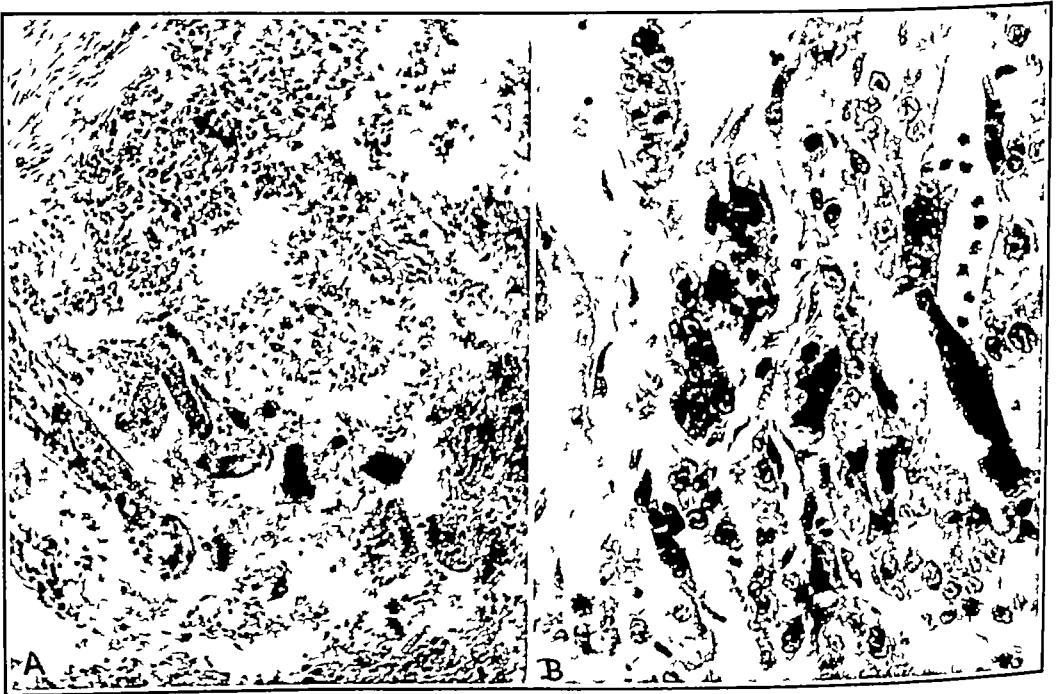


FIG 286 —Photomicrograph of a chorionepithelioma showing large syncytial cells taken from a metastasis in the lung *A*, low power, *B*, high power The gross appearance of this tumor on section is shown in Fig 294

and rapid course simulate an acute inflammation. Even in these cases, however, local tenderness is absent or relatively slight. The skin of the scrotum is freely movable over the mass, although it may appear red and shiny from being stretched. Involvement of the scrotum and ulceration though are very late manifestations (Fig. 293). The spermatic cord may be thickened from the weight of the tumor but not from invasion until very late. Though the inguinal nodes may be palpable, involvement of these nodes occurs only in advanced cases after extension to the scrotum. Gumma of the testicle, hematocoeles, torsion of the cord and epididymo-orchitis, tuberculous forms in particular, need to be considered in differential diagnosis. The main points of differentiation may be tabulated as shown in Table 4, p. 575.

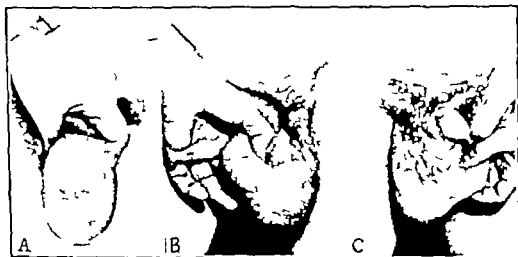


FIG. 288.—Photographs to show the preservation of the shape of the testicle with enlargement caused by tumor. *A* This tumor proved to be a typical embryonal carcinoma. (Table 1 Group C Case 1.) *B* Gumma of the testicle. Wassermann 4 plus. Hormonic test negative. *C* Hydrocele seen as enlargement above the testicle. Hormonic tests of urine and hydrocele fluid were negative.

The main clinical characteristic of testicular tumor is an insidious, uncertain onset without pain or discomfort, of a slowly growing, smooth and solid tumor in a man of from twenty to forty years of age. An abdominal mass or a feeling of resistance may be palpable over the retroperitoneal glandular area. Whenever tumor is suspected the hormone test should be made. If this is not strongly positive there should be no hesitation in performing orchidectomy for diagnosis.

The Hormonic Test in Diagnosis—The demonstration of a gonadotropic hormone in the urine of patients with testicular tumor was accepted when first discovered (by Zondek) as a reliable test. Further studies and experience, however, have proved its fallibility. Conditions other than testicular tumor give rise to a similar hormone and the excretion of such a hormone is very low or entirely absent in many tumors of the testicle. (See Pathological Changes.) Furthermore, irradiation when it has been used extensively in suspected as well as

group of embryonal tumors A negative test, however, does not have the same definite significance

TABLE 3 — QUANTITATIVE HORMONIC EXCRETION
Type 2 Adult Teratoma

	Before operation hormone, M U L	Before irradiation hormone, M U L	Immedi- ately follow- ing opera- tion (within 2 mos) hor- mone, M U L	Immediately following irradiation hormone, M U L	Clinica metastases when first seen A C N	Time since operation or irradiation	Present condition
1	0	0	0	No irradiation	0	6 months	No 1*
2	X	0	0	X	0	3 months	No 1

* (See Table 1 for key)

Symptoms — The first complaint, as a rule, is that of a gradual, painless enlargement of the testicle accompanied by a sense of weight or fullness in the scrotum. The absence of pain with the enlargement is noteworthy. An initial increase in the size of the testicle followed by a period of quiescence, because of which it may have been regarded casually, and then, after trauma, or for no reason, a secondary enlargement which brings the patient for examination, is a not uncommon history.

All ages are affected but the majority of patients (80 per cent, Chevassu) are between twenty and forty years of age. Tumor of the testis is predominantly an affliction of early adult life. However, Julien (1925) collected 139 cases in infants, 25 occurring at birth, 35 in the first and 25 in the second year, and recently there have been several isolated reports of tumors in infants (Balch, 1932). Mixed tumors are the rule in children, monocellular types (seminomata) being very rare (Kutzmann and Gibson, 1923).

The onset of testicular tumors is usually insidious and their tendency toward showing periods of latency in growth renders uncertain the estimation of duration before the diagnosis. As a rule, these tumors grow rapidly and the majority have been present less than one year when first seen by the doctor. More slowly growing tumors, such as adult types of teratoma and an occasional seminoma, have existed several years, although rarely over from three to four, before inducing their bearers to seek medical advice.

Diagnosis — On palpation, the new growth preserves as a rule the usual shape of the testicle (Fig 288). The epididymis is recognizable when the growth is seen early but later it is lost in the enlargement and cannot be palpated separately. In early stages, the surface of the tumor is smooth and regular. It is usually firm in consistency, without stony hardness, and regular. Nodules and irregularities of variable size and consistency and softening and fluctuation over areas of cystic degeneration occur but are usually late. Occasionally a sudden onset

proved cases, may have affected temporarily the output of the hormone. These points should be emphasized. The positive test showing the presence of at least 500 mouse units per liter of urine is almost specific of tumor. The negative test is no proof that the enlargement is not tumor. Irradiation may have modified the test temporarily.

The story of the development of this test in the diagnosis of tumors of the testis is briefly as follows. The testicular neoplastic hormone has been regarded as similar to the gonadotropic hormone found in the urine of pregnant women. In the early investigations of the hormone of pregnancy it was thought to be identical with the anterior pituitary hormone. Zondek, believing that there were two different anterior pituitary hormones excreted in the urine of pregnancy, gave them the names Prolan A and Prolan B. For this reason certain writers have referred to the malignant testicular hormone as Prolan A. Many writers preferring not to assume the presence of two hormones in pregnancy nevertheless adopted the term 'Prolan' to designate the hormone found in the urine of pregnant women in contradistinction to the anterior pituitary hormone. It is now definitely established however that the hormone of pregnancy although similar to is not identical with the anterior pituitary hormone. In the case of male and female castrates and women in the menopause, it has been established that a gonadotropic hormone may be excreted in the urine. Preliminary investigations upon these hormones in other clinics indicate that they are very similar to the anterior pituitary hormone and it is believed that they are identical. Cyclical appearance once a month of a gonadotropic hormone (probably pituitary) in the urine of normal men has been reported (Harris and Brand, 1931).

From these facts one readily sees that in order to discuss intelligently the testicular neoplastic hormone he must be aware of the possible existence of four gonadotropic hormones that may be excreted in the urine. Each should be referred to by its descriptive name to distinguish it from the others.

- 1 Anterior Pituitary Hormone
- 2 Prolan or A P I (anterior pituitary-like) Hormone of Pregnancy
- 3 Testicular Neoplastic Hormone.
- 4 The Hormone of Hypogonadism (castration menopause senility, etc.)

The anterior pituitary hormone and those with hypogonadism are thought to be identical chiefly from their activating or synergistic principle in test animals. Our laboratory has been unable to show any difference between the prolans of pregnancy and the testicular neoplastic hormone.

Zondek (1930) first found that the urine from a patient with a malignant tumor of the testicle may give a positive test for this hormone when such test is carried out on immature female mice. Using the same routine he had devised for the diagnosis of pregnancy he injected small amounts of urine from five to six times in forty-eight hours and

TABLE 4

History	Malignant tumor	Gumma	Tuberculous epididymo-orchitis	Other types of epididymo-orchitis including gonorrhea	Hematocoele	Torsion of the cord
Age	20 to 40	Over 40	Early youth and manhood	At any age	At any age	At any age
Onset	Insidious, chronic	Chronic	Chronic	Acute	Chronic	Acute
Fever	None	None	May be slight	High	None	None
Pain	None	None	Slight	Severe	None	Very severe
Growth	At first, possibly latent, then continuous	Slow	Slow	From rapid to quiescent	Slow except traumatic	From rapid to quiescent
Suppuration	Never	Occasionally	Marked tendency	Varies	No	No
Examination	Smooth or nodular	Smooth, hard "hard ball"	Nodular and adherent	Smooth, indurated, fluctuant	Smooth and fluctuant	Smooth and firm
Palpation	or fluctuant	In testis as a rule	Primary in epididymis	Generally in epididymis but may be in both	In tunica vaginalis	In both testicle and epididymis
Situation	In testis					
Size	Large and growing	Small or medium	Medium	Medium	Medium or large	Medium
Tenderness	None	None	Slight	Marked	Slight	Very marked
Hydrocele	Unusual	Usual	Occasional	Unusual	Associated	Unusual
Scrotum	Negative	Negative	May be adherent	May be red and edematous	Negative	Negative
Cord	Negative	Negative	Enlarged and swollen	Thickened	Negative	Negative
Urine	Negative	Negative	Pyuria	Shreds and pus in fourth glass	Negative	Negative
Prostate and seminal vesicles	Negative	Negative	Nodular	Indurated	Negative	Negative
Glands	Abdominal	None except lymphadenitis of lues	None, or inguinal	None	None	None
Specific test	Gonadotropic hormone	Wassermann	Intradermal tuberculin	Intradermal gonococci	None	None

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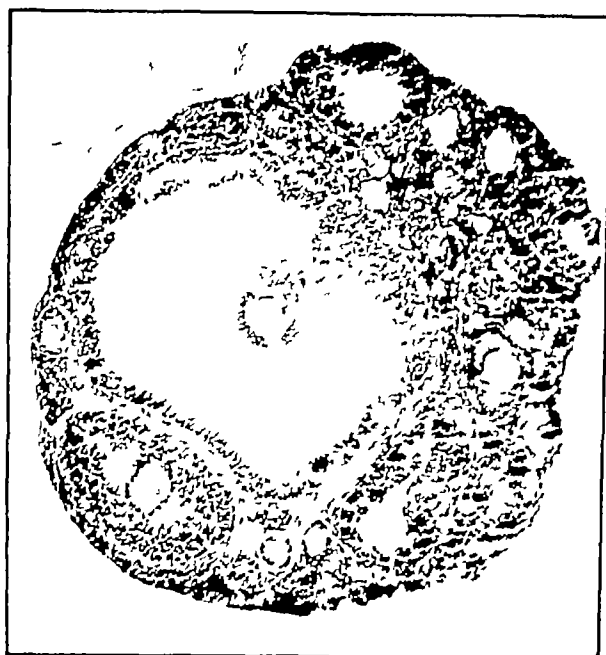


FIG 289 —Reaction I of Zondek Ripening of Graafian follicles

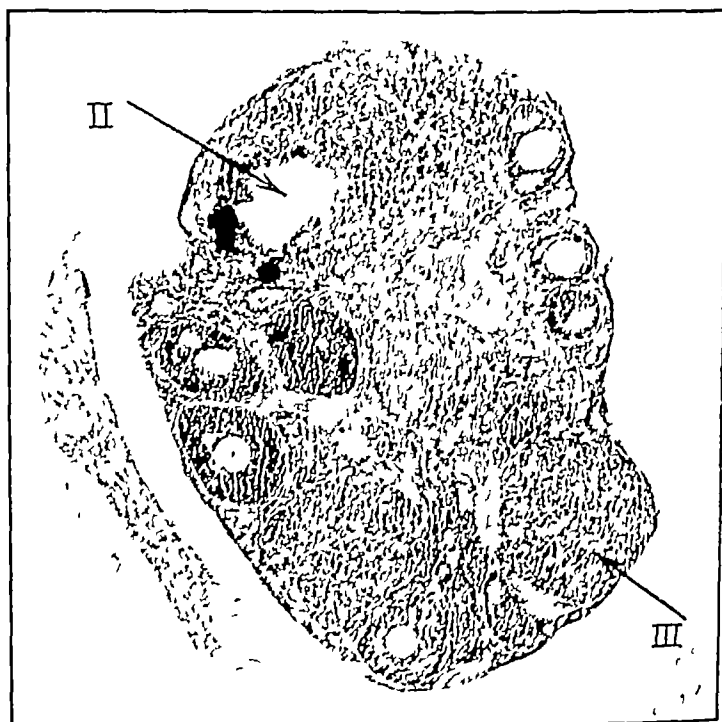


FIG 290 —Reactions II and III of Zondek Formation of hemorrhagic cysts (II)
Luteinization of follicles (III)

killed the animals in one-hundred hours with illuminating gas. In the interpretation of the tests he considered three reactions:

Reaction I—The immature follicles became mature. Mature Follicle Reaction (Fig. 289)

Reaction II—Hemorrhage occurred in the follicles producing the appearance of hemorrhagic cysts or blood points which were easily visible. Hemorrhagic Cyst Formation (Fig. 290)

Reaction III—Intensification of follicles produced corpora lutea (atretic). Leutenization Reaction (Fig. 290)

Zondek at this time was aware of the presence of the follicle-ripening hormone (Reaction I) in 13 per cent of his series of male patients with extragenital carcinoma. (We now think this to be the result of gonadal deficiency rather than of the presence of the neoplasm.) He therefore concluded that Reaction I was not specific for testicular malignancy. He studied 3 cases of testicular tumors which failed to give positive Aschheim-Zondek tests by the use of the patients' unaltered urine but by extracting the hormone by the alcohol-ether method and injecting relatively enormous quantities of urine he was able to produce positive tests. The following year (1931) Ferguson and his associates reported several cases in which patients with testicular tumors had positive I, II or III Reactions. This author concluded that Reaction I (Fig. 289) was specific for these tumors regardless of the quantity of urine injected. Zondek (1932) reported a series of 10 additional cases of malignant tumors of the testicle making a total of 14 cases. In only 3 cases (1 chorionepithelioma, 1 alveolar carcinoma and 1 unclassified because there was no necropsy) was he able to produce positive Reaction II or III. By the concentration method he was able to secure these reactions in only 1 other case. In 4 cases it was not possible to secure even Reaction I by the use of concentrated urine by the alcohol-ether concentration method while in a case of tuberculous epididymitis he produced Reaction I by the concentration method.

Ferguson (1933) reported a series of 117 cases in all of which there were definite reactions; indeed his table for the determination of units would lead one to think that all of these cases gave positive II or III Reactions. Unfortunately this author was able to correlate the excretion of hormone with the histological structure of the tumor in only 37 of the 117 cases.

Technique of the Hormone Test—In tumors of the testis only infantile mice or rats should be used as the rabbit (Friedman test) is unsatisfactory. Although Zondek showed the rat to be five times more sensitive to Prolan than the mouse this has not proved true in our experience with the testicular neoplastic hormone. The follicle-stimulating effect is read much more easily in the ovary of the mouse after microscopic section than in that of the rat and the estrual uterus of the mouse to a greater degree than that of the rat appears to be the ideal test object since men with tumors of the testis do not secrete sufficient estrin to interfere.

Even when using the mouse or rat as the test animal, the term "Negative Aschheim-Zondek Test" is meaningless in regard to tests on the urine for the testicular neoplastic hormone. One must state the quantity of urine injected or the number of units tested for, in stating that the test was negative.

If we do not already know the hormone to be present, we routinely inject 0.2, 0.4, 0.8, and 1 cc of unaltered urine, preferably the first urine voided in the morning. A control animal is always sacrificed at the beginning and at the end of the test, which permits the microscopic study of the normal development of the ovary in comparison with the abnormal. The gross interpretations are equally important. However, unlike those in pregnancy, they concern chiefly the uterine horns. In the positive tests, these will be found to be enlarged, often to a pronounced degree, edematous, clear and colorless. This observation has been confirmed so frequently that we now use it almost exclusively in the hormonal test. By the older method, multiple microscopic sections on all of the ovaries are required. It is apparent that, if multiple sections are made of each ovary of the several animals used for each test, and many tests are run each week, considerable outlay of time and expense is entailed.

Should the test with 0.2 or 0.4 cc of unaltered urine prove to be grossly positive, another series of 4 animals, all of the same litter, is used. These are injected with graduated doses of urine diluted with saline solution so that injections equivalent to 0.025, 0.05, and 0.1 cc are made. In case of negative tests in animals injected with 0.2 and 0.4 cc, but positive with 0.8 and 1 cc, a similar group of 4 animals is used, 3 of which are injected with 0.3, 0.5, and 0.6 cc while 1 is used as a control. In case the test in all of the original animals was negative grossly, the hormone is extracted from the urine by Zondek's alcohol precipitation method. This technique is not infallible and many times the greater portion of the hormone is lost. A similar series of injections with this concentrate is carried out on animals, but it rarely necessitates the injection of more than 0.4 cc. Usually 0.2, 0.3 and 0.4 cc are the quantities injected.

The unit at present is at best on relative terms. There are many variable factors. Five animals, all of the same litter and injected with equal doses of an identical urine, behave differently in a large number of cases. One can at least judge if the quantity of hormone is high, moderate, low or absent. The amount of hormone is estimated on the basis of the ripening of ovarian follicles or pronounced enlargement of the uterine horns. There have been many cases in which a study of multiple sections of the ovaries of the infantile mice showed no apparent stimulation of the ovarian follicles but the tremendous enlargement of the uterine horns in these same animals established the presence of the gonadotropic hormone (Fig. 291). In case hemorrhagic follicles are formed or luteinization is produced, the hormone is estimated in terms of luteinizing hormone. There are probably two factors present in the urine, one of which causes the formation of hemorrhagic follicles, the

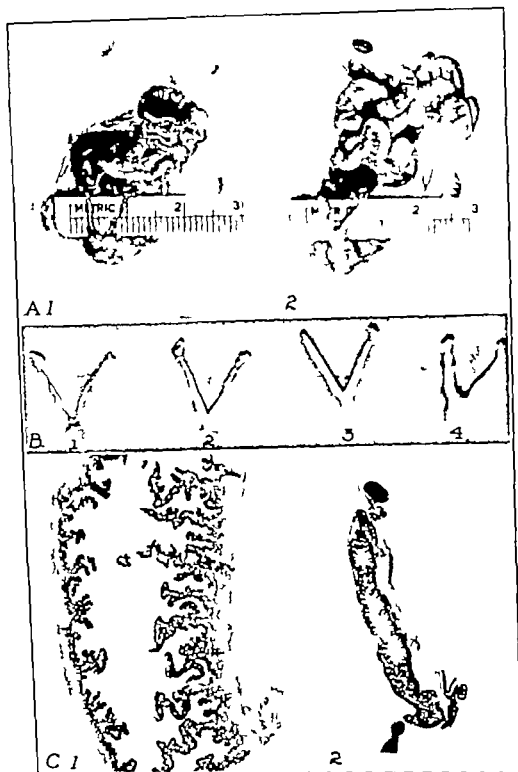


FIG. 291.—A Photograph of the uterine horns of a mouse. 1 The control animal. 2 The injected animal showing Reaction A. B Photograph of a series of uterine horns of mice after removal. 1 Control animal. 2 One plus positive. 3 and 4 Each two plus positive. 4 Shown in A2 above. C Photomicrograph of the uterine horn shown in B4 above. 1 High power showing the marked hypertrophic changes. 2 Low power showing at the top a section of the ovary which has not undergone the same degree of stimulation.

other produces luteinization, but whether there are in fact two different hormones, as Zondek believed to be true of the urine of pregnancy, we, of course, do not know at present. Hamburger showed that, even in pregnancy, there is no constant factor between the follicle-stimulating dose and that of the luteinizing dose.

The mouse unit may be defined, then, as the smallest dose which produces definite ripening of the ovarian follicles or unmistakable enlargement of the uterine horns in the infantile mouse, when the injections are given five times in forty-eight hours, and the animal is killed in one hundred hours. This unit divided into 1000 will give the number of units per liter of urine.

Recently a test which is extremely simple and inexpensive has been adopted in the University of California Clinic. In a large series it has compared so favorably with the Zondek test which has just been described that we use it almost exclusively. It is not only simpler but mistakes are much less likely to occur. The Zondek test is used now only in certain obscure and doubtful cases.

Simple Hormonic Test of Powell — Mice from nineteen to twenty-one days old are used exclusively. The rat is unsuitable for this test. Four animals are injected and a fifth is kept for a control. These animals need not be of the same litter. Using unaltered urine and a No. 27 gauge hypodermic needle attached to a 1 cc. Luer syringe, each of the 4 mice is injected with 1 cc., 0.8 cc., 0.2 cc. and 0.1 cc., respectively, daily for three days and the animals are killed at the end of five days. Mouse No. 1 has received 3 cc. and mouse No. 4, 0.3 cc. The interpretation of the results of the test is based chiefly upon the gross appearance of the uterine horns called Reaction A. The ovaries, however, are inspected by means of a hand lens or binocular. If the uterine horn is at least twice the diameter of that in the control animal the test is regarded as positive (Fig. 292), provided the uterine horn of the mouse injected with a larger quantity was also unmistakably larger than that of the control. The injections mentioned are sufficient to show a range of from 300 ($333\frac{1}{3}$) to 3000 ($3333\frac{1}{3}$) units per liter. *If the amount of hormone is less than 300 mouse units, the test is regarded as negative.* If corpora lutea or hemorrhagic cysts are seen in the ovaries, as well as uterine enlargement, in animals injected with the smaller doses, the urine is diluted to give from one-half to one-tenth this quantity of the hormone or until the smallest dose which will produce the growth-reaction is determined. This dose divided into 1000 gives the mouse units per liter of urine.

The results of the hormonic test in 44 patients with tumor of the testis, whom we have followed, are given in the Tables 1, 2 and 3. This does not represent all of the cases studied for in many instances, the tumors could not be classified because microscopic sections were not available. More than 100 cases were studied either from the hormonic or clinicopathologic point of view.

Judging from these studies and the results of others, the hormonic test seems to have a definite place in the diagnosis of tumors of the

testis and when properly performed and interpreted appears sound and dependable. However it can never replace microscopic diagnosis after orchidectomy and even when the test is repeatedly negative and the clinical picture is that of testicular tumor immediate orchidectomy is indicated just as strongly as before the test was introduced. The real value of the test is in prognosis in the early detection of metastases before they become manifest clinically and as an aid in deciding on the procedure to be followed in the treatment of the individual patient.

In 12 patients, the hormonal test was done before removal of the tumor (orchidectomy) and before irradiation. The test was negative in 3 (2 had well differentiated mononuclear tumors [seminoma] and 1 an adult teratoma) and in 1 with an embryonal carcinoma it was doubtful (200 mouse units). To date the test has not become positive in the last mentioned patient on the contrary the 200 units disappeared following orchidectomy and irradiation (Table 1 Subgroup 3 Case 7). Repeated tests of the other 3 patients have all been negative.

Eight patients had well marked positive tests. Therefore in these 8 patients (Table 1 Subgroup 1, Cases 1 and 2 Subgroup 2, Case 3 Subgroup 3 Cases 2 and 8 Table 2 Subgroup 1, Cases 1 and 3 and Subgroup 2 Case 2) the test gave a positive diagnosis. This is probably about the proportion (8 in 12) in which the test may be expected to be positive. The test is reliable for diagnosis only when strongly positive.

Orchidectomy for Diagnosis—The diagnosis can be determined definitely by histological examination after orchidectomy. Irrespective of the use of orchidectomy as a method of treatment every testicular enlargement which is in any way suspicious of tumor should be inspected surgically without delay. Removal of the testicular enlargement is simple involves no risk and is not mutilating. The loss of a testicle which is tuberculous, luetic or the site of some other form of epididymo-orchitis is negligible should the enlargement prove to be one of these rather than tumor. Removal permits a positive diagnosis so that there can be no doubt that a cure if obtained is of tumor of the testis. Furthermore it is extremely important to learn more about the relation of the structure of the growth to the amount of hormone excreted to the degree of malignancy to the tendency toward and the route of metastasis and to the response to irradiation. The operation should not be in the nature of an exploration. Removal should have been decided on definitely as the right procedure before it is undertaken then the cord can be exposed at the external ring, clamped, tied and divided with a cautery before the tumor in the scrotum has been manipulated in any way thus preventing any possibility of tumor cells being squeezed into the circulation to produce metastases.

As soon as the tumor is removed a large part of it should be placed in acetone before being put in any fixative since such preparations slowly destroy the hormone. Extraction of the acetone tissue then can be carried out and offers the most reliable method of obtaining exact hormonal data regarding these tumors. In one case in which

the urinary excretion was only about 1000 the tissue when extracted showed the presence of 1,000,000 units per 1000 grams In all of our cases in which extraction has been done there has been at least five times more in the tissue than in the urine if it was present in the urine at all

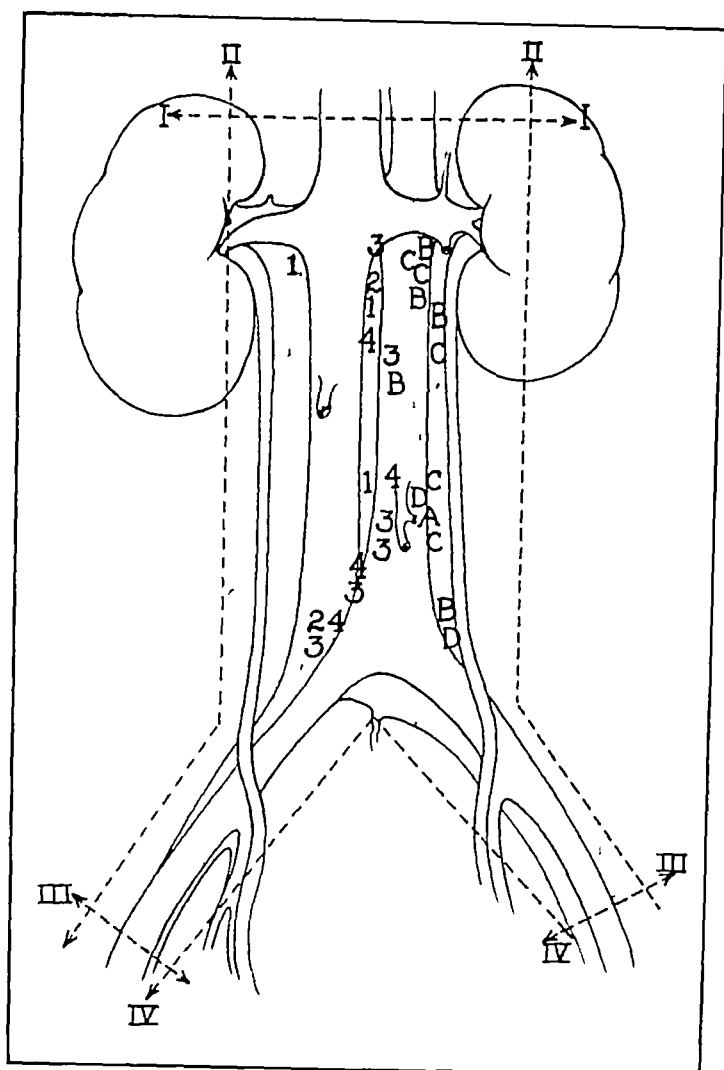


FIG 292 —Diagrammatic representation of the area of distribution of the primary and immediate secondary lymph nodes of the testicle

Metastases —All malignant types of tumors of the testes behave in the same way from the clinical point of view They usually metastasize first to lymph nodes The lymphatic drainage of the testicle directly into the retroperitoneal lymph nodes along the aorta and vena cava has been clearly determined (Most, 1899, Cuneo, 1901, Jamieson and Dobson, 1910) Each testicle has its own primary group of glands which intercommunicate and also receive lymph from other structures The number and arrangement of each group of primary lymph nodes is so variable that the surgeon should have in

round the whole area of distribution rather than any particular arrangement (Fig. 202). For practical purposes this area should include both the primary groups and the immediate secondary nodes (with efferent vessels from the primary) and may be bounded superiorly by a transverse line 2 cm. above the renal pedicle laterally by vertical lines extending from this point on each side 2 cm. outside the vena cava on the right and the aorta on the left to the level of their bifurcation and then prolonged along the iliacs to cross at the upper and middle thirds of each external iliac and inferiorly by following these vessels back from this point to 1 cm. below the bifurcation (Fig. 202). The four dissections (illustrated) show the commonest primary distribution for the right side to be between the aorta and vena cava and upon the aorta and for the left upon the aorta and along its left

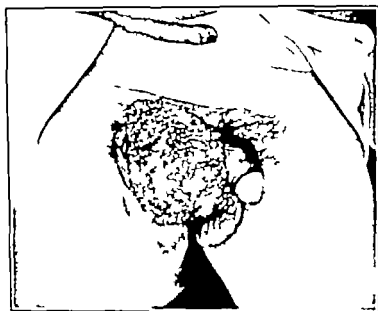


FIG. 203.—Photograph of a patient with embryonal carcinoma showing early invasion of the scrotum with metastases to the inguinal lymph nodes.

border the commonest secondary invasion (not illustrated) is by way of efferents of these primary nodes to glands on the same and opposite sides, to glands immediately above the level of the renal veins, to glands behind and between the two abdominal vessels and to glands along the outer side of the common iliacs. (After Jamieson and Dobson 1910.) The spread from the primary zone into more distant secondary channels (mediastinal epigastric supraclavicular) may be rapid. The inguinal nodes are involved only when the tissues of the scrotum have been invaded (Fig. 203).

Invasion of the supraclavicular area (Virchow's nodes) is not uncommon and means that metastases are general. General metastases (to lungs liver spleen etc.) by way of the blood stream occur particularly with chorionepithelioma. Invasion of bones does not occur. Until recently there was no satisfactory way of detecting the first early

metastases to the deep abdominal lymph nodes. These become palpable only after considerable enlargement, a late stage probably with general metastases. The hormonal test gives promise of some help in the early detection of lymphatic extension. In one of my patients who had had irradiation followed by the disappearance of abdominal metastases clinically, the test became strongly positive several months before any glands could be palpated again. The technician, however, refused further irradiation until metastases became manifest clinically. It was then too late and the patient died. (Just before death he showed the unbelievably high hormonal output of over 1,000,000 mouse units per liter of urine. Table 2, Subgroup 3.) Autopsy showed generalized and extensive metastases. A patient at the California Institute of Technology, aged thirty-eight years, with increase in the size of the left testicle of only three months' duration, had an orchidectomy on September 10th (embryonal carcinoma was found). There was no clinical evidence of metastases on September 25th. The hormonal test had been 8000 before operation but was negative seventeen days after orchidectomy. He was given 7050 r of roentgen-ray therapy between October 2d and 27th. The hormonal test on November 1 was negative. He was given 4725 r of therapy between November 13th and December 1st and the hormonal test one month later was 150,000 mouse units, which dropped to 85,000 after another course of deep therapy. A plain film of the chest showed multiple metastases throughout both lungs. In spite of radiosensitivity of the tumor, the hormonal tests showed the prognosis to be very poor (Table 1, Group A).

Radiosensitivity.—Some of these tumors are highly sensitive to irradiation, others less so, and still others very resistant. This can be predicted only partially by past experience with similar tumors. It can be tested clinically by watching the effect of irradiation upon metastases when present and upon the amount of hormone in the urine. The determination of this sensitivity may be called the therapeutic test of irradiation. From 3000 to 4000 r units to each field, requiring a period of three weeks for administration, will show the relative degree of radiosensitivity by the clinical effect upon metastases, when present, and the biological effect upon the amount of hormone excreted from one to two weeks later. The hormonal reaction indicates radiosensitivity more definitely than has been possible heretofore by a study of structure alone. In mixed tumors, however, the more rapidly growing and major portion of the tumor may be radiosensitive and disappear under roentgen-ray therapy while a small portion, which is highly resistant and malignant, remains. It is only by careful correlation of structure with the results of irradiation, as shown clinically and biologically over long periods, that a better understanding of this variability will be reached.

Irradiation sometimes seems to have an effect on the amount of hormone excreted unrelated to the degree of destruction of the tumor.

Until more is known of this relationship the interpretation of the therapeutic test on the basis of quantitative changes in the gonadotropic hormone must be guarded.

Treatment and Prognosis.—On the basis of these three considerations namely diagnosis metastases and radiosensitivity patients may be divided for purposes of treatment and prognosis into two groups.

Group I contains those patients in good physical condition without clinical evidence of metastases. These can be subdivided by the result of a hormone test two weeks after orchidectomy, into a negative subgroup and a positive subgroup. The negative subgroup includes the few patients who apparently are cured by orchidectomy. All of these patients, however, are not cured and each one should receive a hormone test every three to six months for two years or longer. Reappearance of the hormone in the urine indicates metastasis. Should the microscopic structure of the tumor be similar to that which experience has shown is highly radioresistant early radical removal of the pre-aortic lymph zone should be considered irrespective of the effect of orchidectomy upon the hormone. The disappearance of the hormone after orchidectomy is only relative evidence of cure for early metastases may not produce sufficient hormone in the urine to give a test.

The positive subgroup includes patients with metastases so early or so limited as to give no evidence clinically. Limitation to the pre-aortic lymph zone permits the possibility of surgical removal and cure. This should be attempted except for those growths highly sensitive to roentgen ray therapy as indicated by histological structure and subsequently confirmed by the marked diminution or disappearance of the hormone after a therapeutic dose of irradiation.

Group II contains patients with clinical evidence of metastases. Orchidectomy may be indicated for local relief but is in order mainly for diagnosis. Experience has shown that irradiation is the only curative treatment for these patients. The prognosis depends on the extent and rapidity of growth of the metastases and the general physical condition of the patient as well as on the type of tumor and its radiosensitivity. The condition of the anemic cachectic patient with extensive metastases even though the tumor is radiosensitive, is almost as hopeless as that of the man with a resistant growth.

Summary of Prognosis.—The clinical pathological and hormone studies permit a fairly accurate forecast of the probable course of a patient. The chance of recovery may be estimated as (1) good (2) fair and (3) poor. In the first instance the patient is physically fit, there are no demonstrable metastases and the hormone has disappeared from the urine. In the second the patient is in good physical condition and the structure of the tumor indicates that it will respond well to roentgen ray therapy. However metastases have appeared and the hormone persists even though it is low and is diminishing further under irradiation. In the third the patient is losing ground physically.

metastases to the deep abdominal lymph nodes. These become palpable only after considerable enlargement, a late stage probably with general metastases. The hormonal test gives promise of some help in the early detection of lymphatic extension. In one of my patients who had had irradiation followed by the disappearance of abdominal metastases clinically, the test became strongly positive several months before any glands could be palpated again. The technician, however, refused further irradiation until metastases became manifest clinically. It was then too late and the patient died. (Just before death he showed the unbelievably high hormonal output of over 1,000,000 mouse units per liter of urine. Table 2, Subgroup 3.) Autopsy showed generalized and extensive metastases. A patient at the California Institute of Technology, aged thirty-eight years, with increase in the size of the left testicle of only three months' duration, had an orchidectomy on September 10th (embryonal carcinoma was found). There was no clinical evidence of metastases on September 25th. The hormonal test had been 8000 before operation but was negative seventeen days after orchidectomy. He was given 7050 r of roentgen-ray therapy between October 2d and 27th. The hormonal test on November 1 was negative. He was given 4725 r of therapy between November 13th and December 1st and the hormonal test one month later was 150,000 mouse units, which dropped to 85,000 after another course of deep therapy. A plain film of the chest showed multiple metastases throughout both lungs. In spite of radiosensitivity of the tumor, the hormonal tests showed the prognosis to be very poor (Table 1, Group A).

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Irradiation sometimes seems to have an effect on the amount of hormone excreted unrelated to the degree of destruction of the tumor.

to say which tumor will respond favorably and which will not and this places the indications for radical operation in a very uncertain position. Removal of the testicular tumor by the high incision and division of the cord before attempting to free it from the scrotum is the first step of treatment. Joint consideration of the hormonal output before and after orchidectomy, of the microscopic structure of the growth and of the clinical evidence of metastases permits an estimation of prognosis and the tentative selection of a therapeutic program.

The following is the method which has been in use at the California Institute of Technology since the installation three years ago of high voltage roentgen ray equipment operating at potentials of 800 kv.

Patients Showing No Metastases

- First Series Right and left inguinal portals (10 x 10 cm)
Right and left gluteal portals (10 x 10 cm)
Right and left sacral portals (10 x 10 cm)

1,200 to 1,600 r-units are given through each portal dividing the dose into 300 r a day and using one portal a day—rotating the portals. Time of treatment—from six to eight weeks.

- Second Series Abdominal portals—4 (10 x 10 cm) anterior portals
2 (10 x 10 cm) posterior portals

1,200 to 1,500 r-units are given through each portal, dividing the dose into from 150 to 300 r a day and using from one to two portals a day. Time of treatment—from four to six weeks.

- Third Series Chest portals—4 (10 x 10 cm) anterior and posterior mediastinum

1,200 to 1,600 r-units are given through each portal dividing the dose into 300 r a day and using one portal a day.

Time of treatment—about four weeks.

Patients Showing Metastases

These are given treatment first over the area of metastases and then through the other portals particularly those areas between the primary growth and the metastases.

In some of these patients the first series has been repeated two or three times during a period of two years.

Patients showing metastases have had repeated courses of treatment every six to eight weeks over the definite metastatic area.

metastases resist treatment or rapidly recur and the hormone in the urine is little affected or even increases. Obviously the prospect of a patient may change. Any prognosis is tentative, but is of value in the control of treatment.

Summary of Treatment —The division of patients into the two groups, those with and those without clinical evidence of metastases, is of value chiefly to the surgeon who believes he can accomplish anything by radical operation. An attempt to remove the regional lymph zone is justifiable only in patients in good physical condition and with no clinical evidence of metastasis. The choice of radical operation is permissible for patients with a radioresistant type of tumor, but not for those with the radiosensitive type. The difficulty arises in knowing which tumors are and which are not radiosensitive. The problem may be summarized briefly as follows:

GROUP I

Patients in Good Physical Condition Without Clinical Evidence of Metastasis

- A The gonadotropic hormone disappears within a few weeks after orchidectomy
 - 1 Structure indicates radiosensitivity (Prognosis good)
 - 2 Structure indicates radioresistance (Prognosis fair)
- B The gonadotropic hormone (300 mouse units per liter or more) is still present in the urine several weeks after orchidectomy. The therapeutic test by irradiation
 - 1 Causes its diminution or disappearance, which indicates radiosensitivity (Prognosis fair)
 - 2 Has little or no effect on the amount of hormone excreted, which indicates radioresistance (Prognosis poor)

Treatment Radical surgery is justifiable in A-2 and B-2

GROUP II

Patients With Clinical Evidence of Metastases

- A In good physical condition
 - 1 Radiosensitive tumor (metastases and hormone diminish or disappear under radiation) (Prognosis fair)
 - 2 Radioresistant tumor (Prognosis poor)
- B Anemic or cachectic (usually hopeless irrespective of the type of tumor)

Treatment Irradiation

Radiation —Deep roentgen-ray therapy in all tumors of the testis is the method of choice of the great majority. It is not always possible

The following is a summary of results (kindly given to me by Doctors Mudd and Emery) in 9 patients most of whom have had hormone tests at intervals

Total number of patients	9
Having metastases or recurrence at entry	6
Having no metastases or recurrence	3
Patients having had operation	9
Testicle only removed through the scrotum	5
Testicle and cord removed	4
Radical removal of lymph chain	0
Radiation before surgery	0
Patients living after treatment without clinical evidence of metastases	7
Patients living with metastases (appeared three months following surgery)	1
Patients dead	1
(Six months following surgery pulmonary infarction and emboli. Metastases to pleura are questionable since sections were not made.)	

The course of each of the 9 patients is given in Table 1

At present the prognosis (based on the estimation of prognosis as given above) of the 8 patients still living is good for 2 questionable for 4 poor for 2

Operation.—*Orchidectomy and Removal of the Primary Lymph Zone*—The radical operation for teratoma testis occupies an anomalous position in surgery. It is regarded by the majority as useless, and those few who see some virtue in it are uncertain when to use it.

Radical operation like orchidectomy if done at all must be done early. Therefore if radical operation is of any use it should be done on all patients without clinical evidence of metastases in whom malignant tumor has been proved. When metastases are palpable the operation is impractical since a clean complete removal of the lymph zone most probably will be impossible.

The operation is done in two stages of which orchidectomy is the first. If the radical operation is to be done immediately following orchidectomy confirmation of the diagnosis must be absolute before proceeding. Consultation with an expert pathologist who studies frozen sections before giving his report is in order. A gross diagnosis is too uncertain (Fig. 204 A, B C).

Line of Incision—The incision is so extensive that certain nerve trunks supplying the abdominal muscles and skin over the hip upper portion of the thigh and pubic regions are almost always divided. Nevertheless by curving the incision so as to follow the course of the ilio-hypogastric and ilio-inguinal nerves, the larger and more important branches remain uninjured. In none of my patients have after effects been troublesome. There have been no postoperative hernias or complaints of weakness of the abdominal walls. Several types of incision

TABLE 5

Age	Pathologic structure	Metastases or recurrence at entry	Time between first symptoms and orchidectomy	Time between orchidectomy and x-ray	Time of metastases after orchidectomy	Amount of treatment	Time in which treatment was given	Time since beginning treatment	Present condition	Prognosis
1 47	Embryonal carcinoma	Local recurrence 1000 MUL	12 months	2 weeks 1000 MUL	2 weeks	22,200 r	5 months	6½ months	Dead 200 MUL	
2 33	Embryonal carcinoma	None	2 months	2½ months	None 250 MUL	28,500 r	14 months	21 months	Living and well 0 MUL	Good
3 38	Embryonal carcinoma (very primitive)	None, 8000 MUL	3 months 8000 MUL	3 weeks	Metastases in chest, 4 mos 150,000 MUL	14,775 r	4 months 0 MUL	4 months 85,000-6000 MUL	Chest met 6000 MUL	Poor
4 29	Embryonal carcinoma	Local recurrence 350 MUL	30 months	3 weeks 400 MUL	3 weeks 500 MUL	13,450 r	5½ months	5½ months	Living and well 500 MUL	Fair
5 38	Embryonal carcinoma	Abdominal mass 0 MUL	36 months	2 weeks 0 MUL	Seen at time of surgery 0 MUL	20,490 r	4 months	4½ months	Living and well 400 MUL	Poor
6 37	Embryonal carcinoma	Supraclavicular node	6 months	1 v x-ray 14½ months	Supraclavicular node 13½ months 1000 MUL	17,520 r	7 months 350 MUL	12½ months	Living and well 0 MUL	Good
7 24	Embryonal carcinoma	Abdominal mass	7 months?	18 months	Abdominal mass 5-6 mos?	34,540 r	36½ months 500 MUL	37½ months	Living and well 0 MUL	Fair
8 26	Embryonal carcinoma	Local recurrence 1000 MUL	5 weeks	2 weeks 1000 MUL	2 weeks 1000 MUL	18,300 r	5 months 200 MUL	7 months	Seen in November well then 0 MUL	Good
9 22	Embryonal teratoma	0 MUL	6-7 weeks	5 weeks	None	43,585 r	30 months 1000 MUL	36 months	Living and well 0 MUL	Good

MUL = Mouse units of gonadotropic hormone per liter of urine

shoulders should be more nearly vertical than the hips. The position is a bent dorsolateral one. In later cases, however, patients were placed flat on their backs and the incision was carried up along the edge of the rectus for some distance before curving it out beneath the twelfth rib (Fig. 205). The fascia of the external oblique, internal oblique, transversalis and latissimus dorsi muscles was divided with a scalpel in the line of the incision.

Stripping of the Peritoneum—The only difficulty in stripping up the peritoneum is encountered in the lower portion over the iliac vessels and in the neighborhood of the bladder. As a rule the spermatic vessels as well as the ureter tend to strip up with the peritoneum in

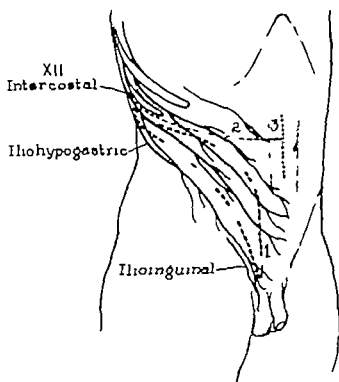


FIG. 205.—Diagrammatic representation of the various types of incisions for retro-peritoneal exposure of the pre-aortic lymph zone which have been used by the author. He prefers the one numbered 1.

this portion. When this occurs it increases considerably the difficulty of a clean dissection. The stripping of these additional structures usually can be prevented by putting gentle traction upon the cord at the time the peritoneum is stripped from along Poupart's ligament so as to keep the cord and its vessels recognizable. The peritoneum can then be stripped back by gentle dissection with gauze without carrying the spermatic vessels with it. At the point where the vas deferens passes down behind the bladder the peritoneal boundaries may be outlined with difficulty. After the vas deferens has been divided at the point where it disappears behind the bladder with gentle traction on the clamp holding the cord the peritoneum usually can be stripped

have been used. In my first cases the incision was extended from the high inguinal incision, previously made over the external ring, to a point about 2 cm. inside of the anterosuperior spine, following the general direction of Poupart's ligament, and then was carried in a curved direction to about 1 cm. below the tip of the twelfth rib which it paralleled for about half its length (Fig. 295). With this incision the position of the patient is of considerable importance in enabling one

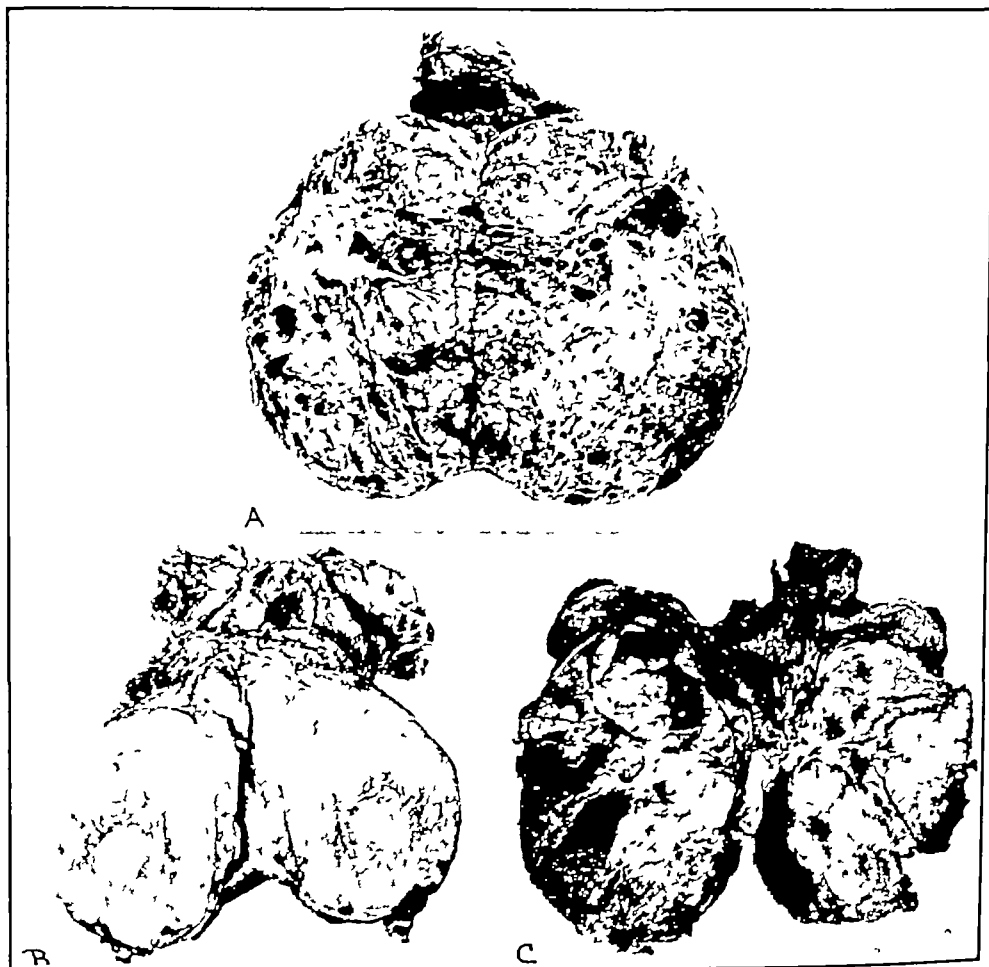


FIG. 294 — Photographs of the gross appearance on cross-section of specimens removed by orchidectomy. A, Embryonal teratoma. B, Embryonal carcinoma (seminoma). C, Chorionepithelioma.

to get a satisfactory exposure of the pre-aortic area. A medium-sized pad was placed under the opposite costal margin. The opposite leg was slightly flexed and the corresponding leg kept straight so as to place the hips in an oblique position. The patient should not be completely on his side but half-way between the lateral and the dorsal position. The usual position for a kidney operation is too extreme for satisfactory exposure. The arms should be folded in front of the patient and the sleeves pinned together to hold them in this position, and the

kidney, and finally the aorta and the vena cava (Fig 297). The peritoneal dissection should be carried to the renal pedicle. The largest lymph glands are found usually at this level and it is important to clean out the area above the renal pedicle. In two postmortem



FIG. 29. —Drawing illustrating the exposure of the lymphatic chain on the right side in which the spermatic vessels and ureter have stripped up with the peritoneum. The insert shows the method of exposing the cord, isolating and dividing it with a cautery before manipulating the tumor in the scrotum.

examinations, invaded lymph nodes were found above the renal vessels. The dissection of lymphatic areas is much facilitated by a complete and thorough retroperitoneal exposure. The peritoneum with the abdominal contents behind it, can be held back with moist gauze sponges beneath broad retractors.

back easily so as to expose the iliac vessels and the aortic bifurcation (Fig 296) The further retroperitoneal exposure of the abdominal aorta is usually not difficult It is easier to start the extraperitoneal



FIG 296 —Drawing showing exposure of the lymph area over the iliac vessels up to the bifurcation of the aorta

exposure at Petit's triangle when the incision has been extended this far along the twelfth rib The gloved hand can be pushed between the parietes and the peritoneal surface, exposing, in succession, the psoas muscles with the ureter overlying them, the lower pole of the

kidney, and finally the aorta and the vena cava (Fig. 297). The peritoneal dissection should be carried to the renal pedicle. The largest lymph glands are found usually at this level and it is important to clean out the area above the renal pedicle. In two postmortem

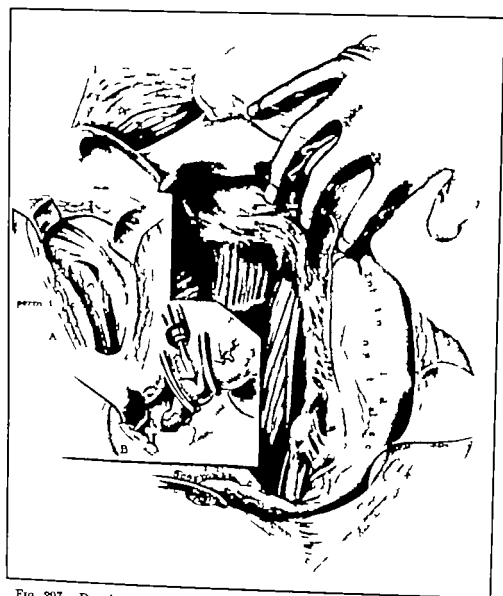


FIG. 297.—Drawing illustrating the exposure of the lymphatic chain on the right side in which the spermatic vessels and ureter have stripped up with the peritoneum. The insert shows the method of exposing the cord, isolating and dividing it with a cautery before manipulating the tumor in the scrotum.

examinations, invaded lymph nodes were found above the renal vessels. The dissection of lymphatic areas is much facilitated by a complete and thorough retroperitoneal exposure. The peritoneum with the abdominal contents behind it can be held back with moist gauze sponges beneath broad retractors.

Resection of Lymphatic Areas—This is likewise more thoroughly done in two stages, (1) dissection of pre-aortic lymph areas and spermatic vessels, and (2) dissection of the lymphatic tissues from the iliac vessels and aortic bifurcation



FIG 298 —a, Drawing to illustrate the exposure of the lymph chain on the right side along the aorta b, Drawing to show completion of the operation The spermatic vessels at their point of juncture with the abdominal vein and artery have been isolated, ligatured and divided before resection is attempted, which may then be carried out from above downward or from below upward

The pre-aortic area may be resected in one of two ways from above downward, or below upward The former is preferable With good retraction and complete peritoneal stripping of the area, an excellent

exposure is possible. The ureter should be carefully dissected free of the fascial coverings and held aside by a narrow tape as shown in Fig. 208. In most cases it was found advantageous to conduct the dissection from below upward to within a short distance of the renal pedicle and then complete the removal of the lymphatic area by freeing it at its upper portion and dissecting down to meet the former dissection. In 2 patients the glands and lymph tissues were adherent to the vena cava in this area. Frequently there was considerable venous oozing directly from the vena cava when small veins were torn or cut at its surface but in no instance was there difficulty in thoroughly ligating these points. In some instances a portion of the wall of the vena cava was seized in the clamp and caught afterward in the ligature. This difficulty was particularly noticeable in the fourth patient in whom the adhesions were most marked. In this patient metastases to the lymph nodes were extensive and apparently there were numerous small venules directly from the vena cava supplying them. In all instances by careful dissection it was possible to remove the spermatic and lymphatic areas *in toto*. The spermatic artery can easily be clamped as it issues from the aorta and the spermatic vein as it enters the vena cava or renal vein the points being easily found when gentle traction is placed on the vessels.

In every case as shown in the illustrations, there were masses of lymphatic tissue lying on the external and common iliac vessels as far up as the aortic bifurcation. This area must be cleaned out separately from that around the spermatic vessels which is accomplished easily by careful blunt dissection with the dissecting scissors beginning low on the external iliac and working along this vessel to the bifurcation of the aorta. At this point lymph tissues may extend deep down onto the sacrum and care in removing them is necessary in order to avoid injury to the middle sacral artery.

Experience has shown that metastases occur to the secondary lymph nodes almost as early as to the primary. Metastases occur in much the same manner in all varieties of tumor. Each testicle has its own primary group of glands which intercommunicate and also receive lymph from other structures. The number and arrangement of each group vary so much that the general distribution rather than any particular arrangement is of clinical importance. The primary lymph nodes anastomose freely through efferent vessels with an immediate secondary group. Invasion of the primary glands on the opposite side and the immediate secondary glands of both sides may occur early. Tumor cells may be carried in the blood stream to the viscera usually the lungs and the liver and when this has occurred operation is useless. The operation therefore should attempt the removal of all the lymphatics of the general distribution of the right and left primary and immediate secondary groups. This generalized area has been clearly determined and may be bounded as in Fig. 202.

The dissection on the right side is much easier than that on the left on account of the superior mesenteric artery on this side so much

easier, in fact, that it is a question whether one should not make the exposure on the right for removal of the pre-aortic and renal lymph nodes even if the tumor is on the left side. In such an instance, a low abdominal incision on the left would be required to remove the lower



FIG 299 —Photograph of patient, after discharge from the hospital, showing the scar of incision 1

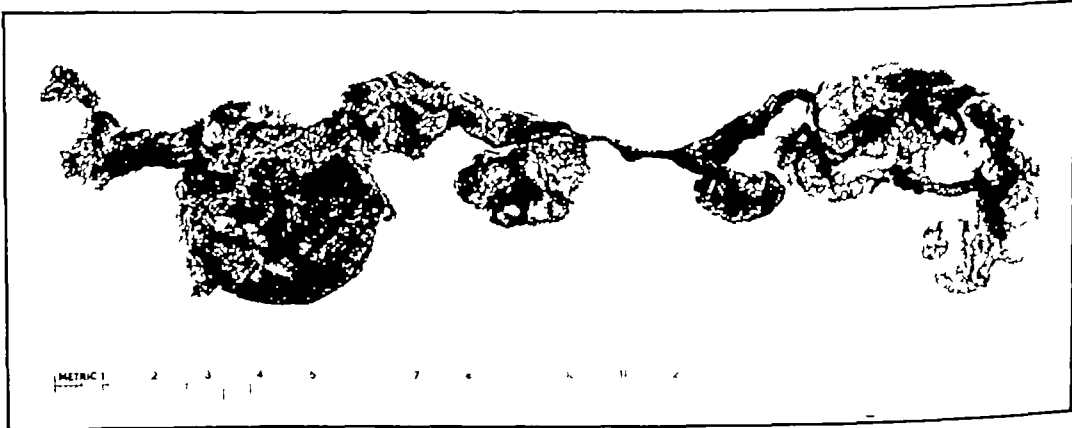


FIG 300 —Photograph of the lymphatic and spermatic vessels and the lymph glands removed from the last patient operated on. None of these glands showed any evidence of metastases

lymphatics at the aortic bifurcation and along the iliac vessels. Fig 299 is a photograph of patient No 12 after discharge and Fig 300 shows the chain of lymph glands removed in the last patient (No 14)

Fourteen patients have had radical operation, 9 for tumor on the

right side and 5 for tumor on the left. Ten are living, all with a good prognosis (no metastases, no hormone in the 3 on whom a test has been made). 4 are dead.

Of the 14 patients who had radical operation, 7 showed metastases in the glands removed at operation. Four of these are living fourteen years, four years and ten months, one year and one month, and three months respectively. Three are dead.

Seven had glands removed which did not show metastases. 6 of them are still living. In 2 of the 7 patients there was an unusual degree of endothelial hyperplasia of the lymph nodes. 1 of these patients is living and well six years and one month after operation; the other is dead. Of the 3 additional patients now living, 1 has lived for eight years and nine months, 1 for two years and eight months, 1 for one year and four months, and 2 for one year after operation.

Of the 44 patients (analyzed in Tables 1, 2 and 3) who have been followed with hormone tests, only 9 had clinical evidence of metastases when first seen. Four of these are dead and each one of the other 5 has a poor prognosis.

Of the 31 patients without clinical evidence of metastases when first seen, 3 are dead, 18 have a good prognosis (3 had radical operation), 2 a fair prognosis and 9 a poor prognosis.

Of the 4 in whom it is not stated whether metastases were present or not when first seen, 2 are dead, 1 has a fair and 1 a good prognosis. The prognosis in most of these patients is purely tentative and most of them have been followed a relatively short time.

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easier, in fact, that it is a question whether one should not make the exposure on the right for removal of the pre-aortic and renal lymph nodes even if the tumor is on the left side. In such an instance, a low abdominal incision on the left would be required to remove the lower

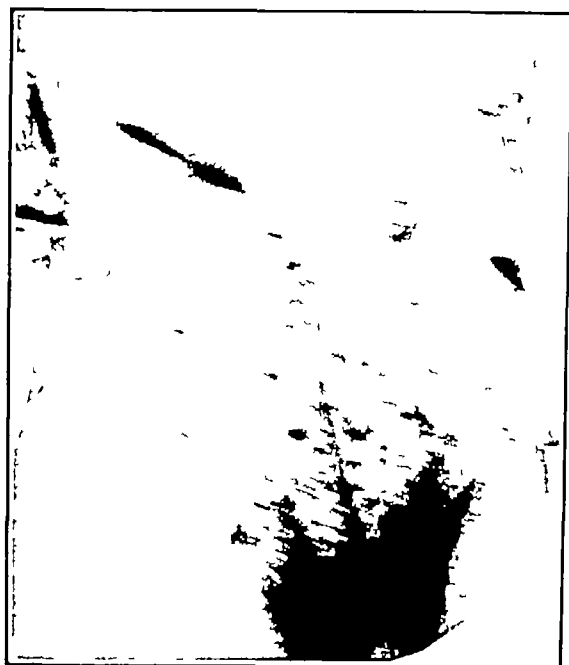


FIG 299 —Photograph of patient, after discharge from the hospital, showing the scar of incision 1

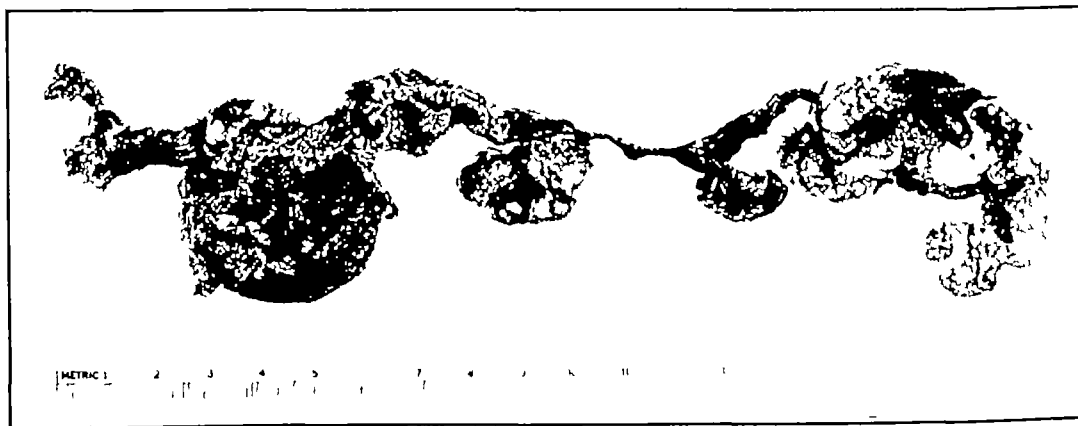


FIG 300 —Photograph of the lymphatic and spermatic vessels and the lymph glands removed from the last patient operated on. None of these glands showed any evidence of metastases

lymphatics at the aortic bifurcation and along the iliac vessels. Fig 299 is a photograph of patient No 12 after discharge and Fig 300 shows the chain of lymph glands removed in the last patient (No 14)

Fourteen patients have had radical operation, 9 for tumor on the

SECTION IV

THE PROSTATE AND SEMINAL VESICLES

CHAPTER XVI

ANATOMY AND PHYSIOLOGY OF THE PROSTATE AND SEMINAL VESICLES

By CERRISHOM J. THOMPSON, M.D., F.A.C.S.

AND

HENRY BUCHTEL, M.D.

THE PROSTATE

Embryology—The primitive cloaca divides into a dorsal rectal portion and a ventral-urogenital sinus. The urogenital sinus elongates and becomes differentiated into two portions a vesico-urethral portion continuous with the allantois and receiving the mesonephric ducts and ureters and a phallic portion extending into the genital tubercle. The expanding vesico-urethral sac invests the ureters and mesonephric ducts which then become part of its walls. Thus a portion of the bladder wall and urethra extending from the ureteral orifices to the openings of the ejaculatory ducts is formed from mesoderm. Chwalla¹ believes the prostate to be entirely of entodermal origin and disputes the possibility of its origin from the urethra as commonly described. Lowsley² describes evaginations from the urethra which develop lumina and are the anlage of the prostate gland. In the sixteen-week old embryo these outgrowths are divided into five distinct groups. One the anlage of the median lobe arises from the floor of the urethra between the bladder neck and the ejaculatory ducts. The anlage of the lateral lobes arise on either side in the urethral wall lateral to each prostate furrow. The anlage of the anterior lobe is found in embryo on the ventral wall or roof of the urethra. It practically always atrophies though rarely may be the site of hyperplasia in elderly men. The posterior lobe arises from the floor of the urethra below the ejaculatory ducts. These groups of glands all enlarge and grow towards the bladder to form the prostate. They are all surrounded by fibromuscular tissue and combine to form the prostate gland as a whole. They are all with the exception of the median lobe bound together by the prostatic capsule which in its formation sends a definite fibrous septum between the posterior lobe and the lateral lobes.

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Two other small groups of glands, the subcervical, which make their appearance at sixteen weeks, and the subtrigonal, which appear at twenty weeks, are of importance because of their causation of urinary obstruction if hyperplasia develops within them.

As the bladder develops, a fold of peritoneum is pinched off between the prostate and the rectum and in the adult this structure becomes the fascia of Denonvillier, which can still be separated into two layers.

The ejaculatory ducts are formed from the mesonephric ducts and pierce the prostate to empty into the urethra at the Mullerian tubercle or verumontanum. The structure which separates the actual openings of the ejaculatory ducts is known as the sinus pocularis, the sole remnant of the fused Mullerian ducts.

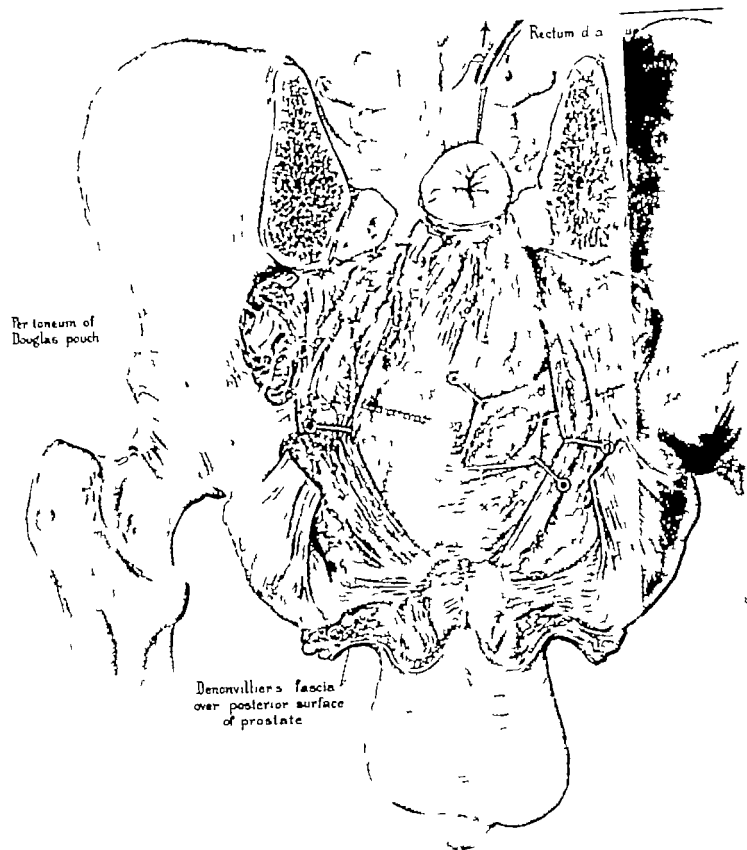
In the final stage of development, the prostatic alveoli empty into a varying number of minute ducts, which in turn empty into the urethra. Anatomists have attempted to establish the number of openings of these ducts into the urethra, but no unanimity of opinion exists.

The prostate gland is an unpaired glandular structure, shaped like a truncated cone with the rounded tip, or apex, directed downwards and resting on the triangular ligament (*trigonum urogenitale*). The anterior shortest surface, looks a little downwards and lies behind the lower portion of the symphysis pubis from which it is separated by the pudendal plexus. The rounded lateral surfaces are bounded by the medial margins of the levator ani muscles and the vesical plexus, which also fills the groove between the base of the prostate and the bladder. The base looks obliquely forward and is concave. The posterior surface is in almost direct contact with the anterior wall of the rectum. The posterior surface is marked by a median groove which incompletely divides the gland into a right and a left lobe. The prostate is pierced from above downwards by the urethra. The ejaculatory ducts pierce the gland also from above downwards and forwards to enter the urethra at the verumontanum.

The organ is invested by a fibrous sheath, and in addition has a fascial bed which may be described as follows. Anteriorly, the puboprostatic ligament, made up of two resistant fibrous layers, one on each side of the midline. Laterally, there is a fascial sheath, derived from the rectovesical fascia which separates the prostate from the levator ani muscles. The posterior surface is separated from the rectum by the fascia of Denonvillier, attached below and anteriorly to the tip of the prostate and triangular ligament, and united above to the peritoneum. Laterally, this fascia projects in a hornlike process on each side which covers the posterior surface of the seminal vesicles.

The surgeon doing transurethral operations is more concerned with the internal anatomy of the prostate than with its fascial attachments, and recognizes that hypertrophy of the various lobes and subcervical and subtrigonal glands, previously described, can cause urinary obstruction. The sole exception is the posterior lobe which is well separated from the urethra by a fibrous sheath which must be broken down before urinary obstruction can occur (Figs. 301 and 302).

PLATE XI



Dissection of Prostate and Seminal Vesicles from Behind to Show Fascia of Denonvillier's. No the Peritoneum between the Two Ampullae of Vasa Deferentia The Sacrum and Coccyx ha

Blood vessels—The arteries of the prostate are branches of the middle hemorrhoidal inferior vesical, and internal pudic (Fig. 303). Bumpus³ has shown that these anastomose on the external surface of

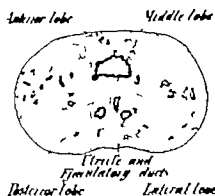


FIG. 301.—The prostate in cross-section. Semidiagrammatic camera-lucida sketch.

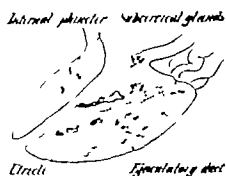


FIG. 302.—The prostate in sagittal section. Semidiagrammatic camera-lucida sketch.

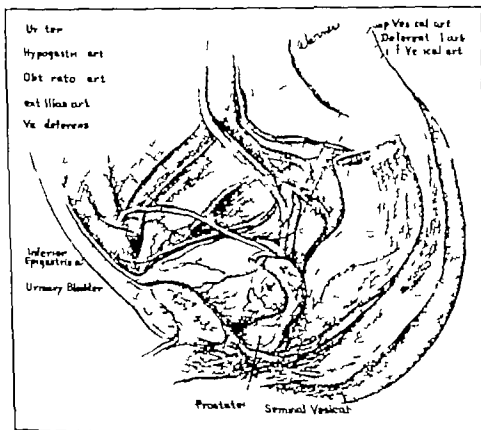


FIG. 303.—Arteries of the pelvis.

the gland then course through it in somewhat parallel branches to form an internal anastomosis just beneath the urethral mucosa (Figs. 304 and 305). The veins leave the prostate at the sides and anasto-

Nerves—The motor nerves, according to Learmonth² originate in the first lumbar ganglia and course down the lateral roots of the pre-sacral nerve to terminate around the prostatic ducts and alveoli. Apparently some sensory fibers are also carried in this nerve although the majority of the sensory nerve fibers originate in the anterior roots of the third and fourth sacrals and are carried by the pudic nerve to the prostate. There is a wide-mouthed plexus of medullated fibers⁴ in the deeper layers of the capsule from which fine non-medullated fibers pass into the prostate and branching freely end between the alveoli of the prostate.

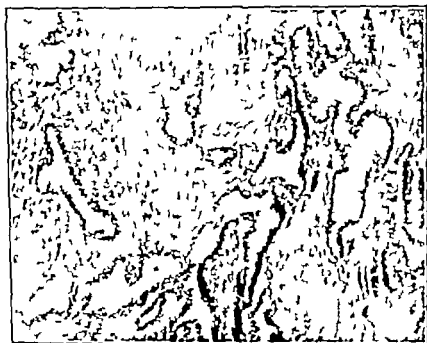


FIG. 300.—Microscopic section of prostate ($\times 90$). Branching tubular glands surrounded by smooth muscle fibers and connective tissue.

Histology—The prostate is a tubo-alveolar gland the glandular tissue comprising about 50 per cent of the substance while fibrous and muscular tissue are in proportion about 25 per cent each. The connective tissue framework in addition to furnishing the capsule and lamella already described also consists of a median septum with radiating partitions which divide the gland into pyramidal lobules. The stroma is rich in smooth muscle fibers. Beginning at their narrow orifices in the urethra where they open in the groove on either side of the median elevation the urethral crest the prostatic ducts pass outwards into the lobules dividing and subdividing into tubules which branch into terminal alveoli. The tubules and acini are lined by a single columnar epithelium which is occasionally two-layered and often forms folds projecting into the lumen. The nuclei are round or ovoid and the cytoplasm contains numerous lipid granules. A basement membrane cannot be distinguished, but the epithelium is surrounded by a fine

mose freely with those from the penis, seminal vesicles, rectum, and vesical region in the pudendal and vesical plexus finally draining into the internal iliac veins

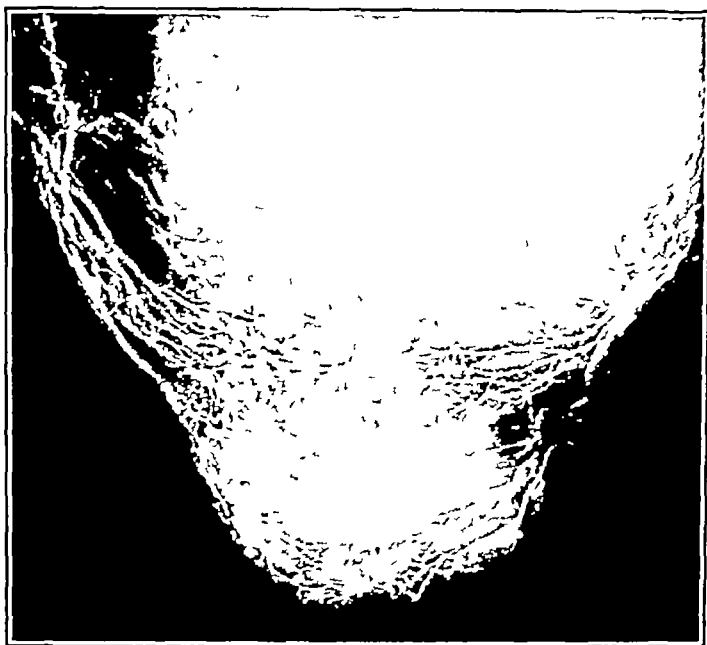


FIG 304



FIG 305

Lymphatics —The prostate is richly supplied with lymphatics which begin around the gland acini and leave the gland to follow the arteries, the vas, or the ureter, or to pursue an independent course into the pelvis to terminate in the pelvic nodes. In a study of 50 human cases, Lloria and Botar¹ found that the highest node with which direct communication was made was the left para-aortic, the lowest the middle retrocrural. The lymphatics of the prostate anastomose freely with those of the posterior wall of the bladder and rectum

mucous membrane consists, on the larger ridges of several layers and in the pits and diverticula of a single layer of low columnar or cuboidal



FIG. 308.—Radiograph of injected vesicles and vasa deferentia. (From Pickel)

epithelium, many of which contain secretion particles. Beneath the mucosa is the tunica propria which is rich in elastic fibers (Fig. 309)



FIG. 309.—Microscopic section of seminal vesicle. ($\times 90$) Very tortuous glands filled with secretion and spermatozoa, and surrounded by a thick muscular wall

THE PHYSIOLOGY OF THE PROSTATE AND SEMINAL VESICLES

The prostate was formerly regarded as having an important muscular function in the physiology of micturition. Now however this is not believed to be so. The function of the prostate is purely sexual.

network of elastic fibers. The ducts are similarly lined except near the urethra where the transitional epithelium of the urethra is found (Fig 306)

Peculiar concretions, corpora amylacea, are often found within certain of the alveoli and ducts, especially in advancing age. They are oval, of brownish color and usually exhibit concentric striation. They probably are derived from the prostatic secretion, and are thought by some to be the origin of prostatic calculi.

THE SEMINAL VESICLES

Embryology — The seminal vesicles originate about the thirteenth week of intra-uterine life as lateral evaginations of the Wolffian duct.

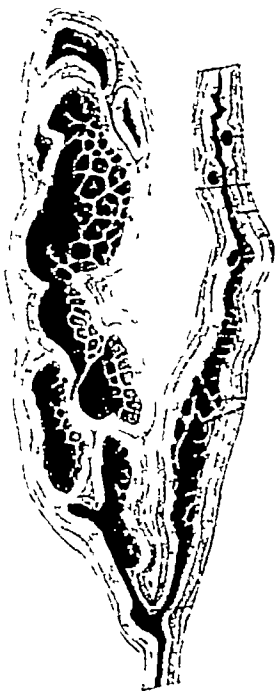


FIG. 307 — Left seminal vesicle and ampulla of vas deferens in section, seen from behind. (From Eberth *Männliche Geschlechtsorgane*.)

Diverticula begin to develop in the tubular structure at about the fourth month which finally result in a convoluted tube whose general appearance remains unchanged during infancy and childhood. At puberty there is a marked increase in the number and diversity of the diverticula, the adult structure resembling a convoluted varicose vein.

Gross Anatomy. — Although flattened antero-posteriorly, the seminal vesicle is on the whole elliptical in shape. It is approximately 5 by 2 by 1 cm in length, breadth, and thickness. Its cubic volume varies considerably but on the average is not much greater than $\frac{1}{2}$ diam. Keyes⁷ states, "The tube is quite as irregular within as without." The fundus of the vesicle lies external to the ureterovesical juncture to which region it is closely bound by fascia (Figs 307 and 308).

The arteries of the seminal vesicle arise from the inferior vesical and the middle hemorrhoidal. The veins join the prostatic and lateral vesical plexus. The lymphatics empty into the pelvic glands and the nerves have the same origin as those which supply the prostate. They form a dense plexus, the plexus myospermaticus, in the muscular tissue from which fibers are sent to supply the smooth muscle, while others penetrate the mucous membrane, and end mostly within the tunica propria.

Histology — In its general structure, the seminal vesicle closely resembles the ampulla of the vas deferens, possessing a smooth muscle coat composed of an inner circular and outer longitudinal layer. The

mucous membrane consists on the larger ridges of several layers and in the pits and diverticula of a single layer of low columnar or cuboidal



FIG. 308.—Radiograph of injected vesicles and vasa deferentia. (From Plicker)

epithelium many of which contain secretion-particles. Beneath the mucosa is the tunica propria which is rich in elastic fibers (Fig. 309)



FIG. 309.—Microscopic section of seminal vesicle ($\times 90$). Very tortuous glands filled with secretion and spermatozoa, and surrounded by a thick muscular wall.

THE PHYSIOLOGY OF THE PROSTATE AND SEMINAL VESICLES

The prostate was formerly regarded as having an important muscular function in the physiology of micturition. Now, however, this is not believed to be so. The function of the prostate is purely sexual

Under sexual stimulation the prostate produces a milky fluid with an average pH of 7.24,⁹ or slightly alkaline, and containing very small amounts of reducing substances and glucose. This fluid is not a motor stimulator for spermatozoa, as motile sperm are regularly to be found in spermatocele fluid and aspirated from the epididymis. In fact, according to Furbinger,¹⁰ an excess of prostatic fluid may be injurious to sperm. In certain animals, the prostatic fluid contains an enzyme which causes the semen to clot,¹¹ but this is not the case in man.¹² It has been stated that there is some substance in the prostatic fluid which causes human semen to liquefy when kept at body temperature after ejaculation.¹³

The majority of present opinion holds that the vesicles do not act as a reservoir^{14,16,16,17} for the storage of spermatozoa, though there are still those who believe this¹⁸ to be true. Apparently their opinion is based upon autopsy findings where the possibility of the sperm migrating into the vesicle postmortem has not been excluded. This has been shown to occur in animals.¹⁴

The function of the prostate and seminal vesicles, then, is to furnish a vehicle in which the spermatozoa are transported to the female genital tract, and possibly protected by this fluid from injury by the vaginal secretion. The importance of the prostate and vesicles is shown by an experiment by Stemach¹⁹ in which he removed the prostate and vesicles from rats. It was found that the sex urge was unaltered and that the animal was able to discharge motile spermatozoa, but that fertilization did not take place.

Spermatocele fluid contains no acid soluble phosphorus or glucose and has a pH varying between 6.91 to 7.7. Semen, on the other hand, has a pH of 7.05 to 7.25 and contains large amounts of glucose, calcium, acid soluble phosphorus, and small amounts of chloride. The chemistry of semen is practically unaltered by vasectomy.⁹ It is evident therefore that the spermatozoa are in a greatly changed chemical environment after ejaculation but the reason for, and the importance of, this fact are at present unknown.

The prostate and vesicles are dependent upon the testis hormone for their proper development. This is evident because of the failure of development of these organs if castration is done before puberty. It has been found that administration of the testis hormone will prevent the atrophy of the prostate²⁰ and seminal vesicles²¹ in the castrate. The prostate is more sensitive in its response to the effect of testis hormone than are the vesicles.²² This is true even after the animal has been subjected to hypophysectomy,²³ thus showing the effect is directly on the prostate and not indirectly through some pituitary hormone. It must be remembered however that the testes are not self-regulating organs but are controlled by the anterior lobe of the pituitary gland.²⁴ Removal of the pituitary is followed by cessation of spermatogenesis and hormone secretion.²⁵ Experimental work by Martins and Rocha²⁶ have led to the theory of the duality of the testis hormone. After similar experiments Lower and his associates have advanced the theory that the testis hormone which is elaborated by

the interstitial cells,²⁷ is responsible for the integrity of the prostate. The secretion of this hormone is under the control of the pituitary which is in turn controlled by a second testis hormone which is secreted by the germinal epithelium. Atrophy of the germinal epithelium in old age results in the controlling hormone being diminished in quantity consequently the amount of primary testis hormone is increased leading to hyperplasia of the prostate.²⁸ This theory has been assailed on the ground that there is no relation between the number of interstitial cells in the testis and the size of the prostate and that the interstitial cells are decreased in number in the aged.²⁹ The duality of the testis hormone has also been disputed.³⁰

Ejaculation.—Evidence that the pre-sacral nerve is the motor nerve to the prostate and seminal vesicles is provided by the fact that stimulation of this nerve leads to muscular contraction and resultant discharge of the prostatic and vesicular secretion.³ There is loss of the power of ejaculation following resection of the pre-sacral nerve. Individuals subjected to the operation are however potent and are often capable of experiencing a psychic orgasm. Evidence has been advanced that the central nervous system has a great deal to do with ejaculation. Battelli's ejaculation test is an interesting example of this central control.³¹ By stimulation of the head of a guinea pig with an alternating current of 80 volts ejaculation is induced. This method of producing ejaculation is specific no urination or defecation occurring during the test.

Normally sperm are transported through the vas deferens by the pressure from behind of spermatogenesis. It is doubtful if the ciliated epithelium of the tract plays any part in the progress of the spermatozoa. Since the seminal vesicles are not organs for the storage of sperm a certain number of spermatozoa are lost in the urine at all times. During sexual excitement this normal mechanism is increased by an increased rate of spermatogenesis and the duct system is emptied of its contents by rhythmic contractions of the walls of the canal of the epididymis the vas deferens and the ampulla of the vas.³² These contractions carry the sperm to the outlet of the ejaculatory duct from which they are carried forward in common with the vesicular secretion by contraction of the urethral muscles to the outlet. Semen is prevented from entering the bladder by contraction of the internal sphincter. According to Keves, science as well as experience demonstrates that the vesicles are not emptied by a single orgasm.

Internal Secretion.—Attempts to prove the existence of an internal secretion of the prostate gland have met with no great success and at present it is not clear whether the prostate has an internal secretion and if one exists, its function is likewise not proven. Total prostatectomy in dogs is followed by atrophy of the testes which has been corrected by injection of prostatic extracts or the implantation of prostatic tissue.³³ V. Fuler³⁴ and others^{35,36} found that watery extracts from the prostate of man and other animals has a pressor effect. Chromaffin cells have been described in the ductus deferens of the dog and the prostate of a rat which have been thought to be the source of

TOMY AND PHYSIOLOGY OF THE PROSTATE

ine-like substance. On the other hand, a depressor substance extracted from the seminal vesicles,³⁷ and shown to be human semen³⁸. Stimulation of the presacral nerve increases the hemoglobin content of the blood,³⁹ and tadpoles fed on prostatic tissue experience an earlier metamorphosis than do controls, but this is not a specific property of prostatic tissue as thyroid tissue will produce the same effect. Rabbits fed prostatic tissue, on the other hand, have their development considerably retarded. Men are found to react more strongly to intradermal injections of prostatic tissue than do women.⁴⁰ Judging from this variety of effects it seems probable that the prostate possesses an internal secretion of some sort, but at the present stage of our knowledge, its exact function is unknown.

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CHAPTER XVII

SURGERY OF THE SEMINAL VESICLES *

ROBERT CUTIERRÉZ A.B. M.D. F.A.C.S.

Introduction.—The surgical history of operative procedures upon the seminal vesicles constitutes rather a recent chapter in modern urology the first attempts in this direction dating from less than fifty years ago when Ullmann¹ performed the first vesiculectomy for tuberculosis of these organs.

The true importance of the subject however was not perceived until the doctrine of focal infection was put forward to explain the pathogenesis of certain systemic diseases of unrecognized etiology. Fuller² in 1896 was the first to call attention to the role of the seminal vesicles as foci of infection in gonorrheal rheumatism. In more recent years, with the introduction of accurate means of diagnosis the relation of these organs to the production of arthritis became evident^{3, 4} and as a result many modern surgeons have modified and improved their technique—Young⁵ Squire⁷ Caulk⁸ Cunningham⁹ Geraghty¹⁰ Lowalev¹¹ Morrissey and Smith¹² Voelker¹³ Lichtenberg¹⁴ Thomson Walker¹⁵ Hunt¹⁶ Gutierrez¹⁷ and others.

The diseases of the seminal vesicles, as well as the anatomy embryology physiology and surgical pathology of these organs have long been properly recognized in the medical literature (Guelliot¹⁸ Iuvs¹⁹ Chauvin²⁰ Minet²¹ Dillon and Blasdell²² Barney²³ Cunningham⁹ (alas,²⁴) and will not be discussed in this chapter.

The symptomatology of these diseases, as well as the complications arising from gonorrheal infections and also their diagnosis and the medical and urological treatment, have been covered by other writers in this book.

It is the intention therefore of the author on the basis of his own experience with 150 vesiculectomies without a death to discuss only the surgical treatment and the classic operative procedures. In doing this however he proposes to point out the special advantages and the convenience of the perineal route of approach to the vesicles, as it is used in perineal prostatectomy.

THE SEMINAL TRACT

The seminal tract is formed by the testes epididymides vasa deferentia ampullae and seminal vesicles, together with the ejaculatory ducts.

* The author of this chapter is preparing a monograph on "Surgery of the Spermatie Tract," to be published in the near future to which readers are referred for a more detailed discussion of the subject.

The embryological development of the seminal tract is so intimately related to that of the urinary tract that the pathology arising from embryological malformations of one of these systems is likely to affect the other system also, as we shall see later in the surgical anomalies

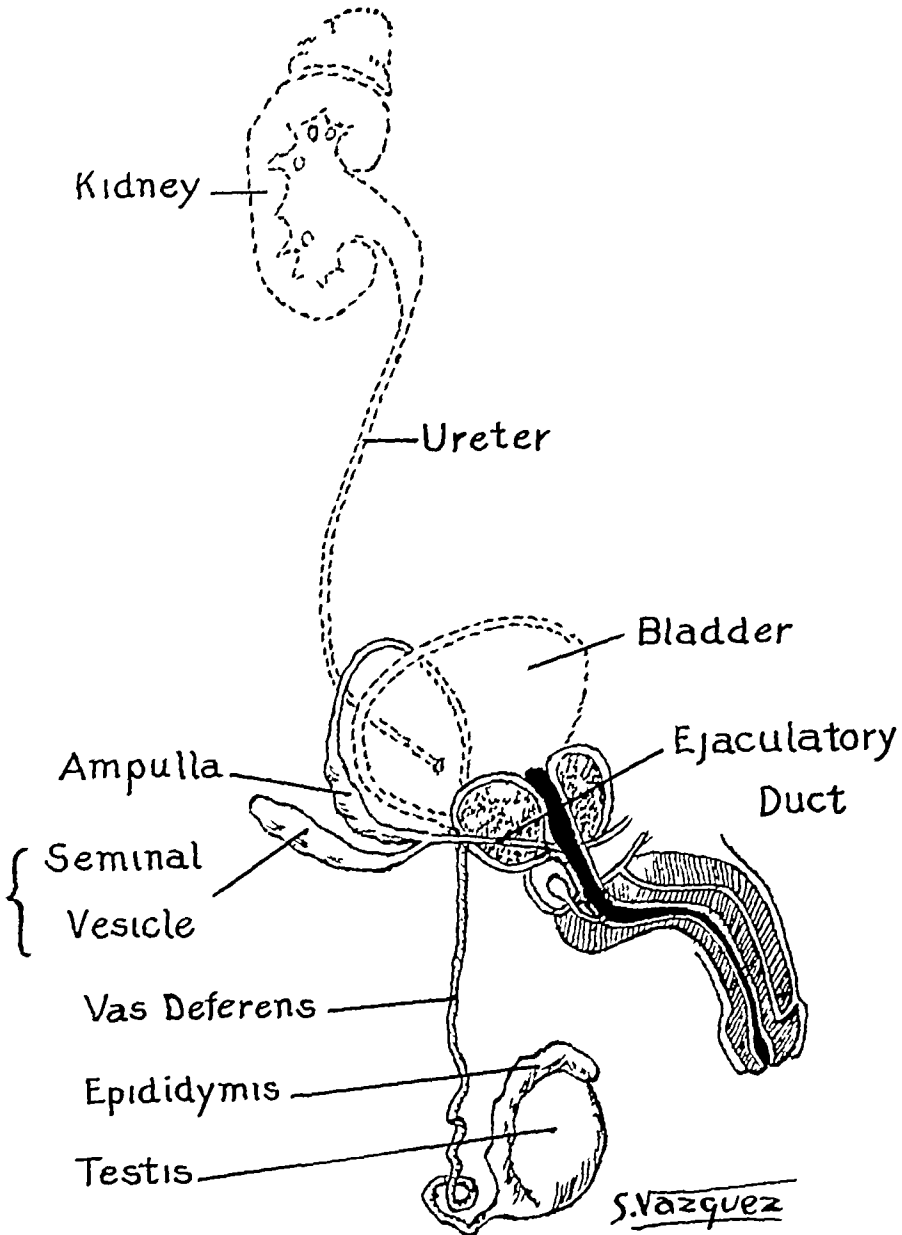


FIG 310 —The interrelationship of the spermatic and urinary tracts

of the seminal vesicles. An anatomical conception of the interrelation of these two systems, both of which are derived from the Wolffian body and ducts, is shown in Fig 310.

The seminal vesicles are two symmetrical lobulated pouches lying within the small pelvis at the right and left of the midline, between

the bladder in front and the rectum behind above the level of the prostate and below the pelvic peritoneum. Their tapering lower extremities approach one another as they descend and merge into the minute ejaculatory ducts which discharge their content into the urethra through two small orifices at the right and left of the prostatic utricle (Fig. 311).

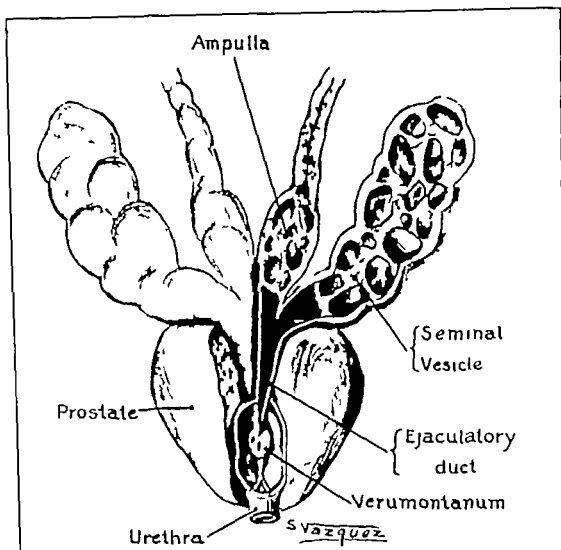


FIG. 311.—Posterior view showing the form and gross structure of the seminal vesicles and ampullae and their intimate anatomical relation with the prostate.

The ampullae which constitute the enlarged and convoluted terminals of the vasa deferentia lie between the two vesicles and in intimate contact with them. They partake of the same lobulated structure as the vesicles.

The vasa deferentia are two canals ascending by a tortuous route from the right and left epididymis, respectively, carrying the seminal fluid from the testes to be stored in the vesicles. Passing in front of the ureters over the postero-lateral aspect of the bladder they follow

the contour of the superior and internal aspects of the vesicles in two oblique lines, running downward and inward as the lower end of each vesicle approaches its mate. The ampulla of each vas is separated from its respective vesicle only by a long, slender spur, beneath which it meets and unites with the neck of the vesicle to form the ejaculatory duct at the upper surface of the prostate.

The internal arrangement of the seminal vesicle, and to a less degree of the ampulla, is that of a long principal tube rolled up into a great number of convolutions with deep lobulations which are filled with intercommunicating alveoli, incompletely divided by septa, the whole resembling the appearance of a honeycomb. This arrangement is of great importance surgically, since it is this that makes drainage of these organs so difficult by any natural channel (Fig. 312).

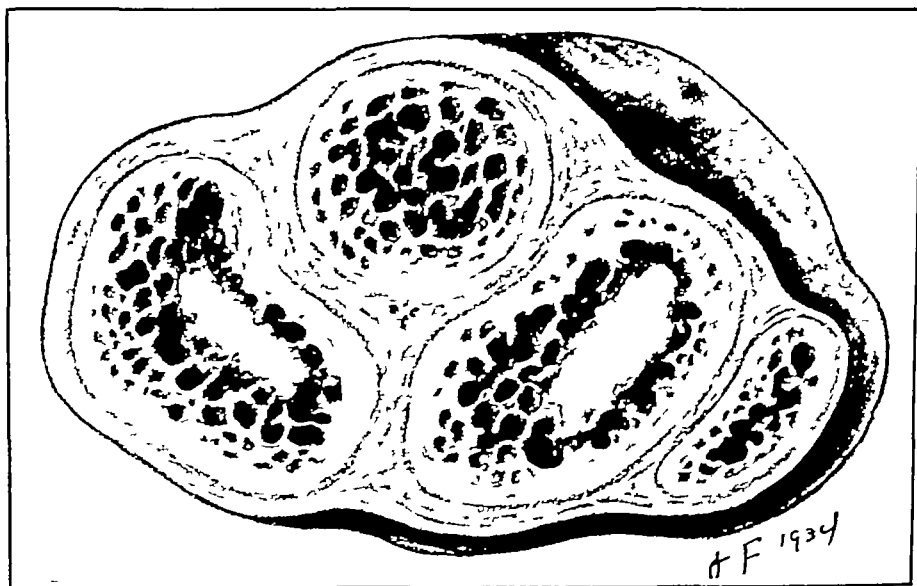


FIG. 312 — Cross-section of the seminal vesicles, showing the interior network with its extraordinary number of sacculations, convolutions and diverticula, which render surgical drainage by simple vesiculotomy or multiple incisions practically impossible for the elimination of infection, thereby explaining the tendency to chronicity in vesiculitis. (Redrawing from B. A. Thomas, Jour. Am. Urol. Assn., 1916.)

Denonvillier's Fascia — The seminal vesicles and ampullæ are covered with two layers of white glistening fascia known as Denonvillier's fascia, which figures largely in the surgery of these organs, serving as a landmark in the perineal approach.^{25 26 27 28} This fascia runs from the apex of the prostate to approximately the base of the bladder, where the two layers coalesce and continue as the peritoneum, constituting the so-called prostatoperitoneal aponeurosis.^{29 30} (Fig. 313).

Surgical Topography of the Male Perineum — In the surgical anatomy of the seminal vesicles and prostate, the perineum occupies a strategic position, with its complex anatomical structure of muscles, fascias and aponeurosis, a clear knowledge of whose interrelations is of vital importance in any operations to be performed on these organs by the

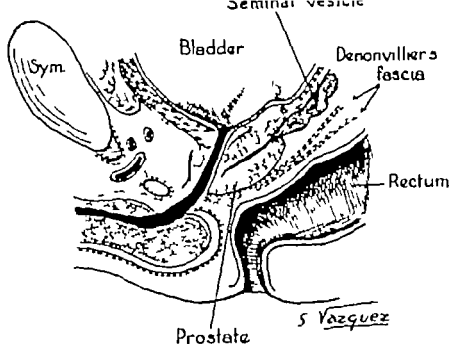


FIG. 313.—Denonvilliers fascia or aponeurosis and its anatomical relation to the prostate and seminal vesicles. (Modified from Albarran's *Médecine Opératoire des Voies Urinaires*, Masson et Cie Paris, 1900)

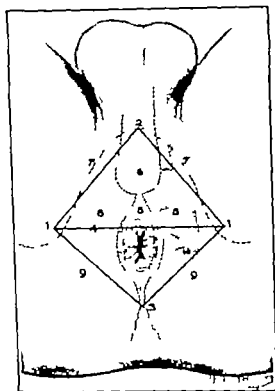


FIG. 314.—Surgical topography of male perineum showing the perineal rhomboid and its two triangles, which constitute the surgical landmarks of the region. 1 Right and left tuberosities of the ischia 2 angle of the pubis at the bulb 3 tip of the coccyx 4 line joining the two tuberosities of the ischia, corresponding to the line of union where the deep layer of the superficial fascia meets the base of the triangular ligament 5 central point of perineum coinciding with the anal sphincter 6 bulb of the urethra, in the central tendon, which unites it to the anal sphincter 7 right and left ramus of the ischia and pubis 8 right and left ischioanal fossae 9 margin of right and left gluteus maximus muscles 10 left internal pudic artery giving off its inferior hemorrhoidal branches and its superficial perineal and other branches to the superficial muscles of the perineum and the bulb of the urethra.

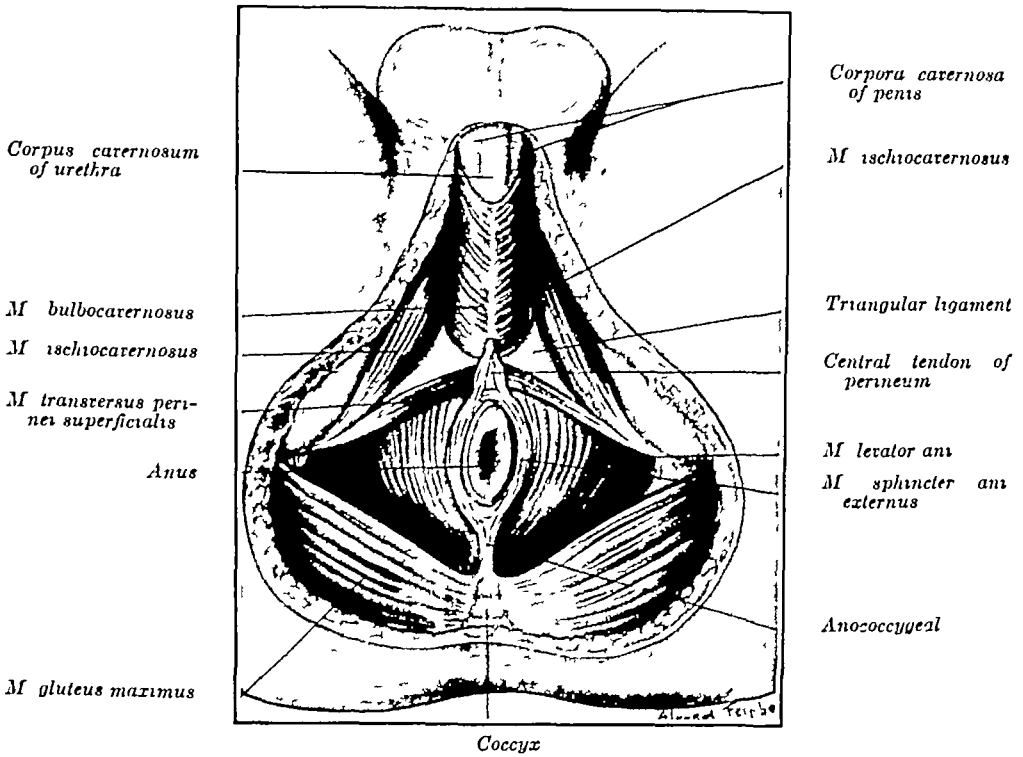


FIG 315 —Dissection of the superficial muscles of the perineum

M cavernosus

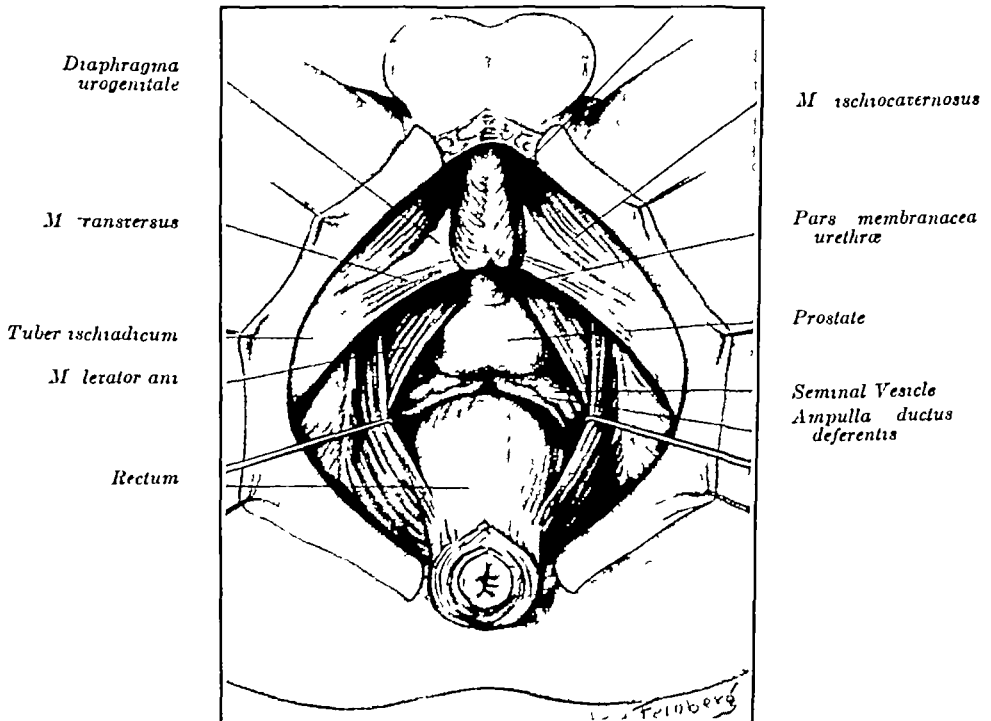


FIG 316 —Dissection of the deep perineum, showing the relationship between the surface of the prostate, the seminal vesicles, ampulla and vasa deferentia. The central tendon and recto-urethralis muscles have been divided, the bulb retracted to expose the membranous urethra and the rectum pulled backward, giving ample room for surgical approach to the prostate and seminal vesicles

perineal route of approach. In its description three parts deserve particular attention namely *the perineal rhomboid the superficial perineum and the deep perineum*. The essential elements of these anatomical regions are graphically illustrated in Figs. 311, 313 and 316.

SURGICAL CONDITIONS DUE TO ANOMALIES OF THE SEMINAL VESICLES

There are certain definite gross anomalies that are more or less frequently encountered in the seminal tract. Most of them affect more than one organ of the tract and not infrequently involve the urinary tract as well thus revealing their relation to arrests of development which lead to atrophy or functional disorders of the organ or organs in question resulting finally in surgical pathology. These abnormalities explain the close embryological relationship between the urinary and spermatic tracts which becomes especially evident when one notes for example how often there is recorded in the literature a ureter opening into some part of the spermatic tract and the extensive pathology resulting therefrom. The various anomalies which I have collected from the literature are classified in Figs. 317 and 318.

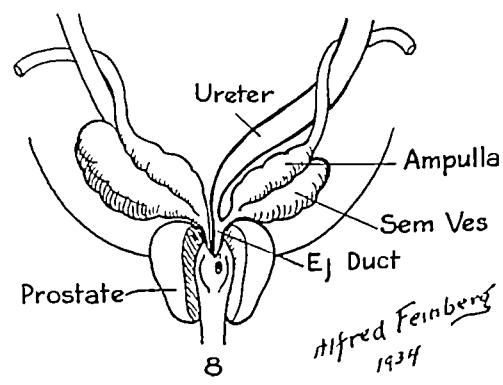
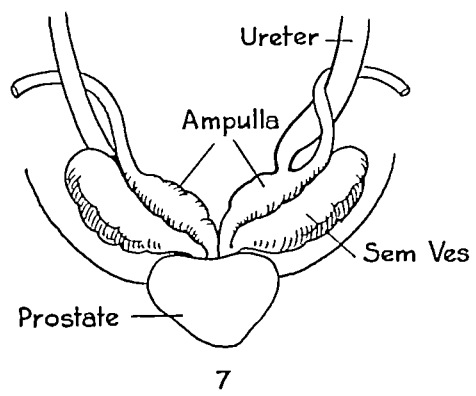
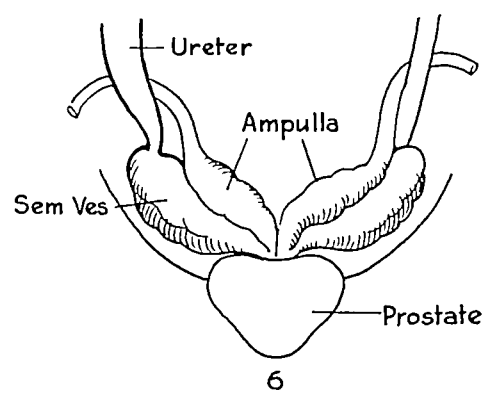
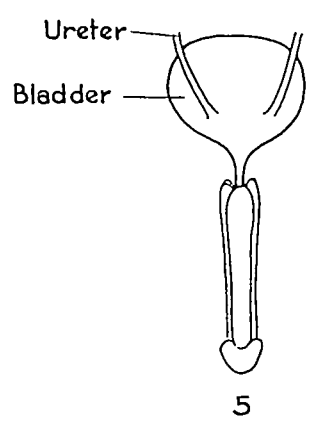
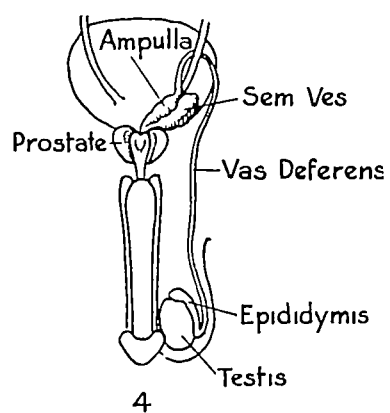
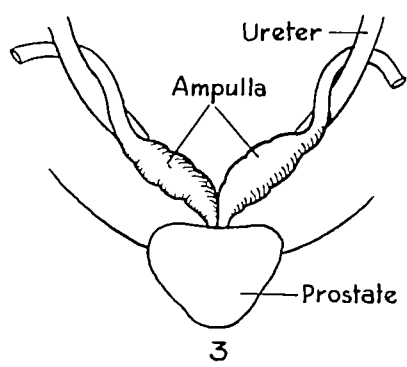
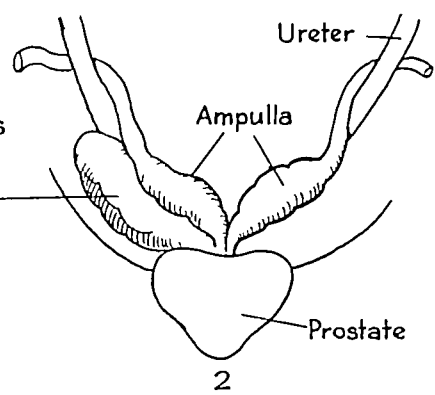
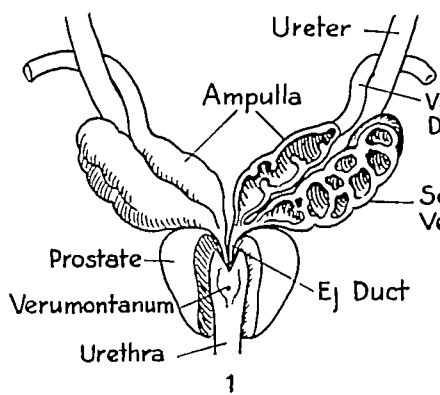
SURGICAL PATHOLOGY OF THE SEMINAL VESICLES

Vesiculitis.—Approximately one-half the lesions of the seminal vesicles are produced by the *infection of these organs with the gonococcus* followed by other infections that are secondary. On the other hand seminal vesiculitis or spermatocestitis is frequently the result of urinary infection that has no relation whatever to gonorrhoea. Even when vesiculitis is of gonorrheal origin the gonococcus is rarely found since it disappears early in the course of an infection and the bacteria found consist chiefly of the streptococcus, staphylococcus and the *Bacillus coli*.

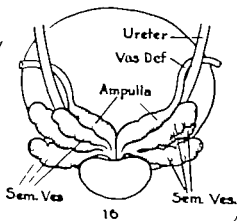
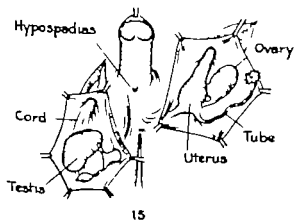
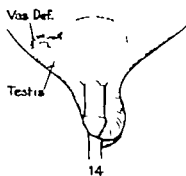
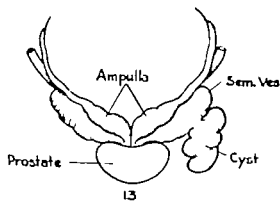
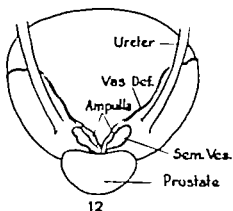
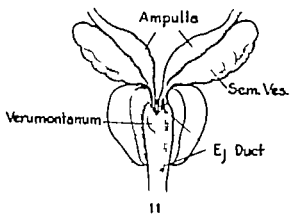
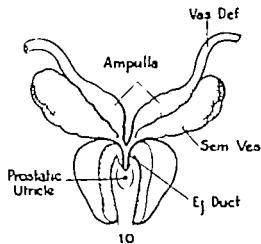
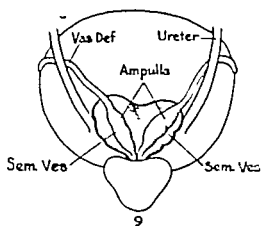
LEGENDS FOR FIGS. 317 AND 318

FIG. 317.—Classification of the anomalies of the seminal vesicles and spermatic tract as collected from the literature. 1 The normal type of vesicles, ampullae and their adnexa, 2 absence of one seminal vesicle, 3 absence of both seminal vesicles, 4 absence of one-half of the spermatic tract including one seminal vesicle, ampulla, vas deferens, testis, epididymis and ejaculatory duct, 5 complete absence of spermatic tract including prostate and verumontanum, 6 an ectopic ureter opening into one of the seminal vesicles, 7 an ectopic ureter opening into one of the ampullae, 8 an ectopic ureter opening into one of the ejaculatory ducts.

FIG. 318.—Classification of the anomalies of the seminal vesicles and spermatic tract as collected from the literature. 9 Fusion of both seminal vesicles, 10 fusion of the two ejaculatory ducts to open in one orifice at the utriculus prostaticus, 11 an additional ejaculatory duct opening into the membranous urethra, 12 hypoplastic or undeveloped seminal vesicles, ampullae and vasa deferentia, 13 cyst or diverticulum of one of the seminal vesicles, 14 undescended testicles and vasa deferentia, 15 true hermaphroditism showing presence of both male and female genital organs, 16 multiple seminal vesicles (two or three on each side).



Alfred Feinberg
1934



The sacculated formation of the vesicles and ampullæ so predisposes to the retention of an infection once established within them that it is almost impossible to eradicate it by other than surgical measures. Absorption from this source is now known to be responsible for many cases of arthritis and rheumatism, for certain cardiac affections and for various other conditions due to blood- and lymph-borne infections, among which are certain functional psychoses or toxic infections of the nervous system. Inflammatory changes of the seminal vesicles may extend to the surrounding tissues and result in urethritis, prostatitis, cystitis, trigonitis, ureteritis and even nephritis, or the order may

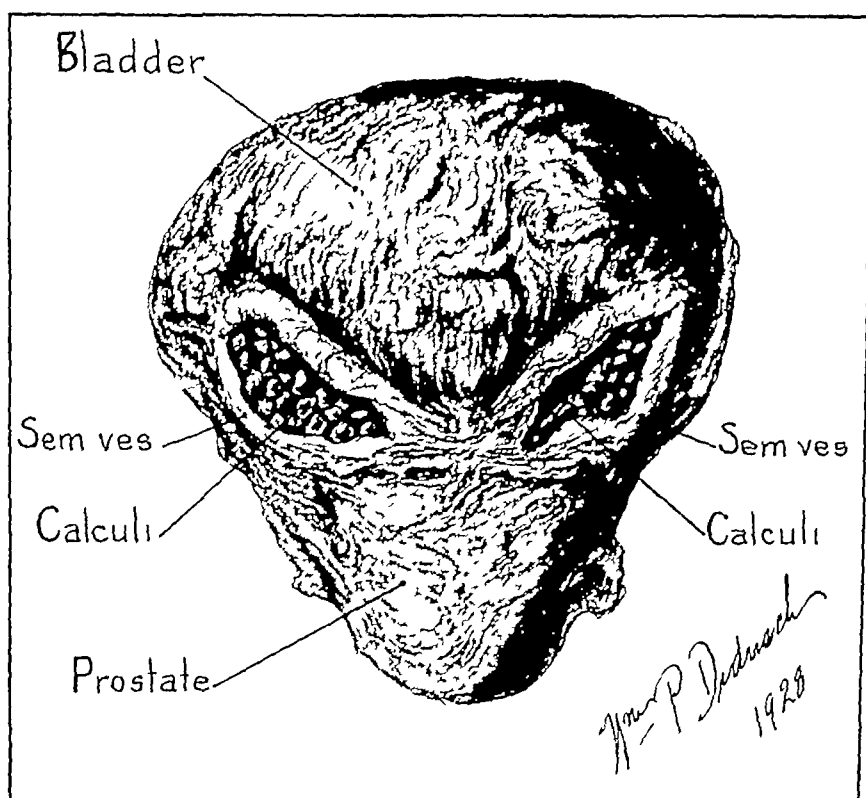


FIG 319 — Multiple calculi in both seminal vesicles. Drawing from postmortem specimen in a patient thirty years of age. (Gutierrez, Jour Am Med Assn, 1929)

be reversed and any one of these conditions may lead to vesiculitis. According to Marion³¹ the presence of chronic vesiculitis in a patient suffering with prostatism is a sign strongly suggestive of malignant degeneration of the prostate. Not infrequently, too, after performance of a prostatectomy or an endoscopic prostatic resection, the failure of urinary disturbances to clear up may be attributed to the presence of an acute vesiculitis.^{32,33,34}

Tuberculosis — Tuberculosis is another common lesion of the seminal vesicles, and this is alleged to be responsible for tuberculous infection of the prostate, bladder and kidney, as well as of the epididymides and

testes. Occasionally it results in fistula into the rectum, bladder or perineum. With the modern means of investigation this condition comes more and more into the domain of surgical treatment.

Other Pathology—In addition to the various infections occurring in the seminal vesicles there are many other surgical conditions found, chief among which are *stones*, *diverticula*, *cysts* and *tumors*.

Spermatic Colic—Spermatic colic indicates occlusion of an ejaculatory duct from *stone*, *stricture* or *muscular spasm*. Calculi may be

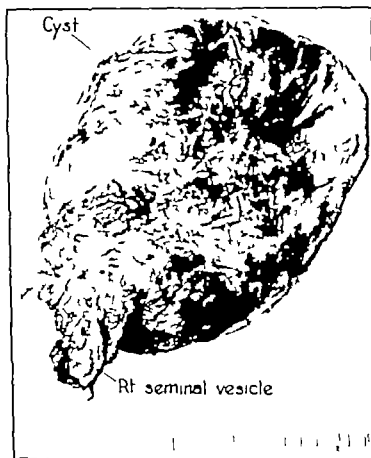


FIG. 320.—Photograph of an enormous cyst of the right seminal vesicle containing 1100 cc. of dark chocolate-colored fluid which microscopically shows red blood cells and a number of spermatozoa. Specimen removed at operation in a patient fifty-nine years of age. (Courtesy of C. L. Deming, New Haven 1934.)

unilateral but are more frequently found on both sides (Fig. 319). More common than true calculi are pathological *concretions* composed of symplexons that is of agglomerations of nitrogenous bodies formed within the semen as well as mucous concretions entangling clumps of spermatozoa which contain but little organic matter but which may pass by insensible transitions into true calculi. These concretions and calculi may be found within the seminal vesicle itself or within the ampulla, the vas or the ejaculatory duct. They may even go so

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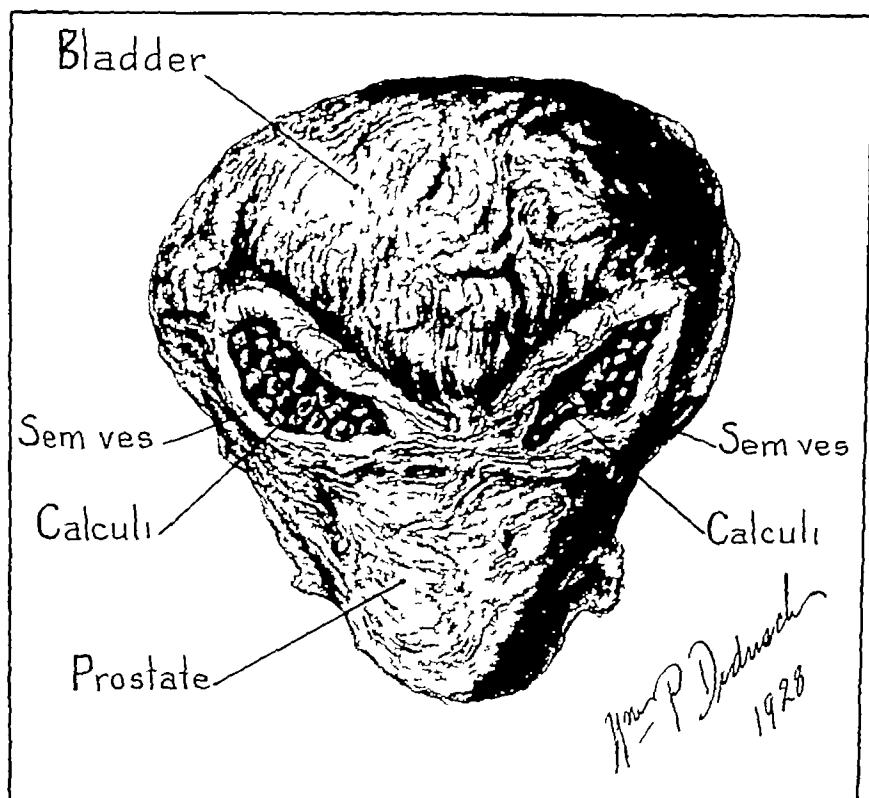


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bony or general metastasis (b) those in which malignancy originating in the prostate has involved the seminal vesicles, and in which a perineal total prostato-ampullo-vesiculectomy can still be carried out and (c) those in which the neoplasm originates in the retrovesical space, from which it invades the vesicles

7 *The Postoperative Group*—Cases in which the patient after perineal or suprapubic operation of any type but especially after vesiculotomy or prostatectomy continues to suffer from urinary symptoms and sexual disorders requiring radical relief and in which the infected seminal vesicles, engorged and inflamed are the direct cause of the patient's postoperative complaint

In all these types of cases surgical measures are indicated to bring about relief. In some of them this can be accomplished by surgical drainage (vesiculotomy) in others excision of the seminal vesicle or vesicles is required (vesiculectomy) and indeed the latter is the operation of choice whenever conditions permit

Minor procedures upon the vas deferens that have been devised for drainage of the seminal vesicle and ampulla such as the well known vasotomy of Belfield⁴⁶ and the vasopuncture of Luvy^{41, 42, 43, 44, 45, 46} as well as catheterization and drainage by the natural route through the ejaculatory ducts^{41, 47, 48, 49} will not be discussed here

VESICULOTOMY

The Value of Surgical Drainage of the Seminal Vesicles—In view of the extremely irregular and complicated structure of the seminal vesicles with their numerous crypts and recesses it becomes evident that in the event of a chronic infection no effective drainage by any natural route is possible and that recourse must therefore be had to surgical incision. It is true that where the vesicle is composed of a comparatively straight and simple tube with but few diverticula and sacculations early spontaneous resolution may sometimes be possible or drainage may be effected by massage of the organ but the majority of vesicles are not of this type. In most of them it is necessary therefore to lay the substance of the vesicle wide open and to incise the various individual compartments in order to provide for artificial drainage on an adequate scale. Theoretically this can be done through an abdominal incision by dividing the rectovesical fold of the peritoneum but practically the safest and most advantageous approach is through the perineum (Fig. 121). Several techniques have been devised for the procedure of which the first to be worked out and standardized was that of Fuller.⁵⁰

Seminal Vesiculotomy—Fuller's Technique—With the patient in the knee-chest position on an inclined table with head downward a broad U-shaped incision is made with the arms of the U at the sides of the anus and spreading outward at the top (back) while the horizontal base passes 3 cm. in front of the anus. The vertical arms are prolonged backward as far as the base of occyx. This wide incision per-

far in extreme cases as to cause complete calcification of both vesicles, as Albarran,²⁸ Kretschmer³⁵ and also Lepoutre³⁶ have reported

Cystic and Ectatic Formations.—Cystic and ectatic formations arising from the seminal vesicles are a more or less frequent finding. In some cases they attain a great size and may even fill the entire abdomen. A photograph of an enormous cyst of this kind removed at operation, containing 1100 cc. of fluid is shown in Fig. 320 (Deming³⁷)

Tumors—The type of neoplasm most commonly met in the seminal vesicles is *sarcoma*, which is ordinarily an extension of sarcoma from the prostate or bladder (Berger,³⁸ Teubert,³⁹ Bumpus,⁴⁰ Young,⁴¹ Pauchet,⁴² Fenwick,⁴³ Zahn,⁴⁴ Wassiljeff⁴⁵ and very recently Pelagatti⁴⁶). Primary carcinoma is rare (Young,⁴¹ Lyons,⁴⁷ Kudlich,⁴⁸ König⁴⁹) but secondary carcinoma is not infrequent, being commonly propagated, like sarcoma, from the malignant prostate.

Clinically, three types of malignant tumor of the seminal vesicle have been recognized: one originating in the vesicle itself, one arising from the tissues behind the bladder in the retrovesical space, and one in which the new growth develops in the prostate and extends to the vesicles.

INDICATIONS FOR OPERATION UPON THE SEMINAL VESICLES

The indications for operation upon the seminal vesicles may be divided into seven groups, according to the dominant symptom or manifestation present:

1 *The Inflammatory Group*—Those cases in which both the seminal vesicles and the prostate present acute suppurative lesions, such as are commonly observed both in the abscess type and in tuberculosis of the seminal tract.

2 *The Rheumatic Group*—Cases in which arthritic and rheumatic manifestations are present as the result of a focal infection in the seminal vesicles.

3 *The Pain Group*—Cases in which pain is the essential common factor. Here belong those cases in which perineal, suprapubic or sacroiliac pain is present, with a certain amount of urinary and rectal symptomatology, as well as such manifestations within the spermatic tract as painful erection and coitus, bloody emissions, weakness of ejaculation, and in some cases impotence. In this group belong cases of stone formation, cyst, diverticula and other allied pathological lesions.

4 *The Neurasthenic Group*—Cases in which so-called sexual neurasthenia is present with moderate physical signs of disease in the vesicles.

5 *The Psychotic Group*—Those cases in which the graver forms of mental disorder are present, and in which examination of the seminal vesicles reveals that these organs are suffering with chronic inflammation and distention.

6 *The Neoplastic Group*—Cases in which (a) the malignant lesion originates in the vesicle and is still confined to one or both vesicles, with the invasion not as yet very extensive and with no evidence of

entire length and thus protecting the rectum behind it. With this sound as a guide and the back of the knife gliding in its groove the posterior wall of the vesicle was incised with care not to injure the bladder. A finger was then introduced to enlarge the opening in the vesicle and to remove any collection of pus that might be found after which a curette finished the work of evacuation. A cigarette drain was then placed on each side and the wound closed except for drainage through the horizontal breach.

Cunningham's Modification of Fuller's Operation — In order to operate under vision Cunningham* modified the procedure as follows. After protecting the rectum with a piece of gauze in the bottom of the wound he inserts a flat self-retaining retractor $1\frac{1}{2}$ to 2 inches wide having an abrupt curve and long enough to reach the bottom of the wound. Then by means of a special double tenaculum the prostate is lifted enough to expose the base of the bladder whereupon the vesicles become visible beneath the glistening aponeurosis of Denonvillier. The latter is divided along the upper border of the prostate and stripped back as a whole thus exposing both vesicles at the same time.

Squier's Modification of Fuller's Operation — Squier⁷ uses a different device for the same purpose. After exposure of the prostate he introduces two stout silk sutures through the prostate and bladder wall at the junction of the prostate and base of the bladder placing them as far laterally as possible. Traction is then made upon the sutures in a downward direction resulting in the forward rotation of the base of the bladder through an arc of about 60 degrees thus exposing the fascia of Denonvillier.

Multiple Incision Method — Morrissey,¹¹ Cunningham,⁸ Squier⁷ and some others make use of a procedure in which both vesicles are liberally incised under full vision and all diverticula opened to provide adequate drainage. *Concomitant incision of the prostate* is one of the important steps of the procedure (Fig. 321). After opening Denonvillier's fascia the first incision is made in the vesicle at the point where it joins the ampulla after which numerous incisions are made along the axis of each vesicle and in the prostate. The interior of both vesicles is then swabbed out with phenol and neutralized by alcohol. Sections of the wall are taken for culture and smear after which drainage tubes are placed at the various sites of incision in both prostate and vesicles. The capsule is sutured in two places and the wound closed as in prostatectomy.

SEMINAL VESICULECTOMY

Many different methods and techniques for the removal of the seminal vesicles have been described since the first vesiculectomy was performed in 1889. The various procedures fall primarily into three groups according to the mode of approach. These are (1) the *inferior* (2) the *anterior* and (3) the *posterior*.

1. The *inferior approach* includes 2 different procedures
 - (a) The perineal operation
 - (b) The ischiorectal operation

mits blunt dissection of the tissues lying above the perineum until the prostate is reached, after which the vesicles are oriented by touch at its right and left. Fuller's operation was a blind one, later operators have, however, improved the technique to permit the work to be done under vision. In the original procedure the surgeon introduces his left index finger into the rectum and places it against the anterior wall, where it becomes the buttress against which the various muscles are

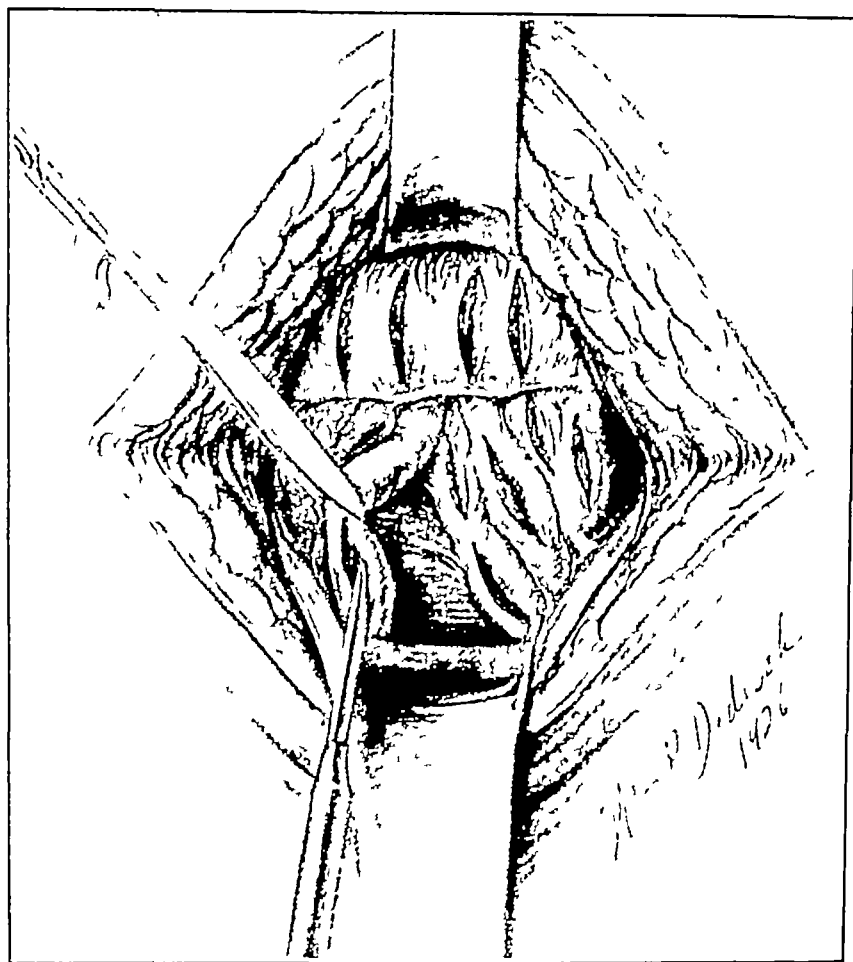


FIG. 321 — Drawing showing the modern method of multiple incision of the anatomically exposed prostate, seminal vesicles, ampulla and vasa deferentia, reached by the perineal route. (From J. H. Morrissey, *Surg., Gynec. and Obst.*, p. 347, 1928.)

cut successively on the way to the vesicle the superficial muscles of the perineum, the levatores ani, and the levatores of the deep perineal aponeurosis. The fascia is picked up and incised over each vesicle, after which the vesicles are laid open and as many punctures or incisions made as are required. Under control of the finger within the rectum, Fuller introduced a grooved sound at this point of the operation, letting the instrument follow the posterior aspect of the vesicle for its

dissection with the blade of the knife and the index fingers the central tendon is divided and the bulb properly retracted. At this time, if any bleeding is encountered from branches of the bulbular artery these are clamped and tied. To prevent unnecessary bleeding special care should be taken not to cut into the bulb.

With perfect retraction of the bulb and perineal flap by the bifid perineal retractor the recto-urethralis muscle is carefully divided and gradually separated from the rectal attachments and from the apex of the prostate. Then by means of the index finger the prostate is gradually liberated and separated from the remaining fibers of the urethralis muscle. The levator ani muscles constituting the floor of the pelvis are then carefully retracted. A few muscular fibers still remain and these are stripped from the surface of the prostate by gauze dissection. The prostate covered by the glistening fascia of Denonvillier is exposed. A superficial transverse incision is made at about the middle of the prostate. The first layer of Denonvillier's fascia is gradually dissected back by the blade of the knife and after being well separated is retracted with the deep perineal retractor. A second incision is then made to dissect the second layer of Denonvillier's fascia as illustrated in Fig. 323-1. It is essential that the two layers of this fascia be carefully separated and that the fascia be stripped well behind the base of the prostate and the base of the bladder for if this is not done the exposure will be most difficult and unsatisfactory.

The enucleation of the vesicle is now begun with the tip of the index finger an attempt being made to reach the tip of the vesicle laterally and externally to the ampulla of the vas deferens. Owing to the numerous adhesions likely to be encountered the exposure of the vesicle is as a rule difficult particularly in those cases where the inflammation is of long standing and in which a process of perivesiculitis is present.

When both vesicles are found chronically diseased they are both removed. Beginning on the left side the vesicle is easily exposed and separated from the ampulla by careful dissection with the help of good retraction and scissors and forceps as illustrated in Fig. 323-3 and 4. After clamping of the left vesicle the right one is exposed in the same manner and similarly clamped the clamping being done close to the duct that unites the vesicle to the ampulla (Fig. 323-5 and 6). The two vesicles are then cut off and the stumps touched with phenol and alcohol after which a single catgut suture is placed on each side as illustrated in Fig. 324-1, 2 and 3. The ampullae are carefully examined at this point to ascertain their patency.

In closing the wound it is particularly important to place 3 or 4 sutures near the edges of Denonvillier's aponeurosis as in Fig. 324-4 in order to reconstruct all the anatomical planes and to give perfect support to the structures of the deep pelvis particularly the new rectovesical space together with the prostate rectum and peritoneum. Finally two cigarette drains are inserted one inside the prostatovesical space and the other in the rectovesical space behind the recon-

- 2 The *anterior approach* embraces 3 separate procedures
 - (a) The suprapubic method
 - (b) The transvesical method
 - (c) The inguinal method
- 3 The *posterior approach* comprises 4 different procedures
 - (a) The sacral method
 - (b) The parasacral method
 - (c) The coccygoperineal method
 - (d) The anococcygoperineal method

Indications for Vesiculectomy —The principal indications for vesiculectomy are tuberculosis of the seminal tract, tumors of the vesicles, cyst formation, certain abscesses, calculi, and an important group of cases characterized by chronic inflammation, gonorrheal or non-gonorrheal, in which the vesicles act as foci of infection, menacing the health of the entire body

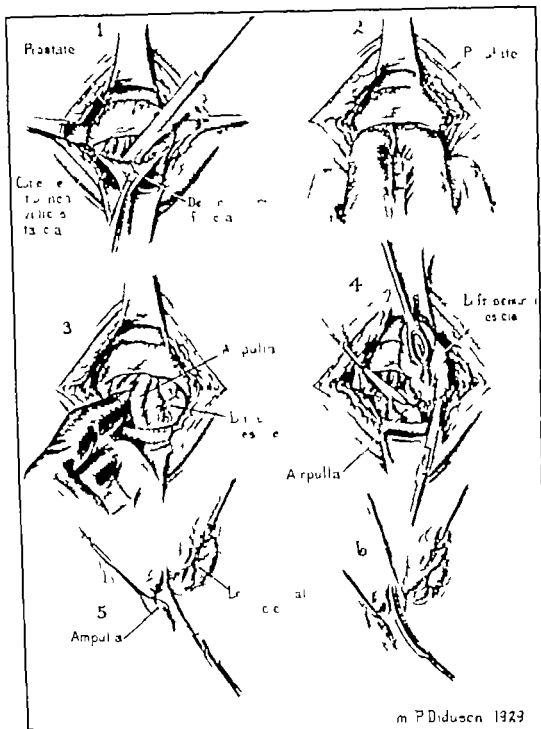
THE PERINEAL OPERATION.

This method of removal of the seminal vesicles was the first to be employed (Ullmann, 1889), and it has continued to receive the preponderance of support from later operators. The advantages of this route for exposure of the prostate and seminal vesicles were early pointed out by Zuckerkandl,⁶² Ullmann,¹ Roux,⁶³ Weir,⁶⁴ von Dittel,⁶⁵ Lloyd,⁶⁶ Albarran,²⁸ Proust,⁶⁷ Guelliot¹⁸ and Baudet and Kendirdjy.⁶⁸ The original perineal method has more recently been modified by Young,⁶ Squier,⁷ Caulk,⁸ Cunningham,⁹ Geraghty,¹⁰ Lowsley,¹¹ Morrissey and Smith¹² and Gutierrez,¹⁷ and the method with its modifications remains the operation of choice. It is *extraurethral*, *extravesical* and *extraperitoneal*, hence the common sequels mentioned in the literature, such as vesical, perineal or rectal fistula, peritonitis, epididymitis and urinary incontinence, are not encountered.

The various steps in the perineal procedure as performed by the author are illustrated in Figs 322, 323 and 324.

Anesthesia —In most instances general anesthesia under nitrous oxide and ether has been employed to produce narcosis, but local anesthesia may also be used with satisfactory results. In some cases the epidural method, or the method of sacral or parasacral block infiltration, has been deemed best. It appears that the most simple of all methods is spinal anesthesia, using as a medium novocaine, nupercaine or spinocaine. In reality the type of anesthesia chosen should be the one that the operating surgeon selects as the one most suitable for the individual case.

Operative Technique —With the patient in the exaggerated lithotomy position as for perineal prostatectomy, and with the urethral seminal vesicle tractor in position, a semilunar incision is made at the raphe of the bulb, just between the scrotum and the rectum, running from one ischial tuberosity to the other (Fig 322-1). The incision is carried deeper into each side of the central tendon, and then by blunt



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FIG. 323.—Operative technique of the perineal method. 1. Dissecting second layer of Denonvillier's aponeurosis from the posterior face of the prostate with the handle of the knife; recognition of these two layers of prostatic fascia is essential. 2. Index fingers separating deeply by blunt dissection Denonvillier's aponeurosis from the base of the prostate and stripping the layers back from the base of the bladder to free vesicles from rest of fascia. 3. Enucleation of the seminal vesicles with the finger tips, after careful blunt dissection of tip of vesicle. 4. Dissection of seminal vesicles from the fascial plane of adhesions, and separation from ampullae. 5. Method of separating and dissecting the seminal vesicles entirely free from the ampullae. 6. Method of clamping and excising the seminal vesicles from the ampullae.

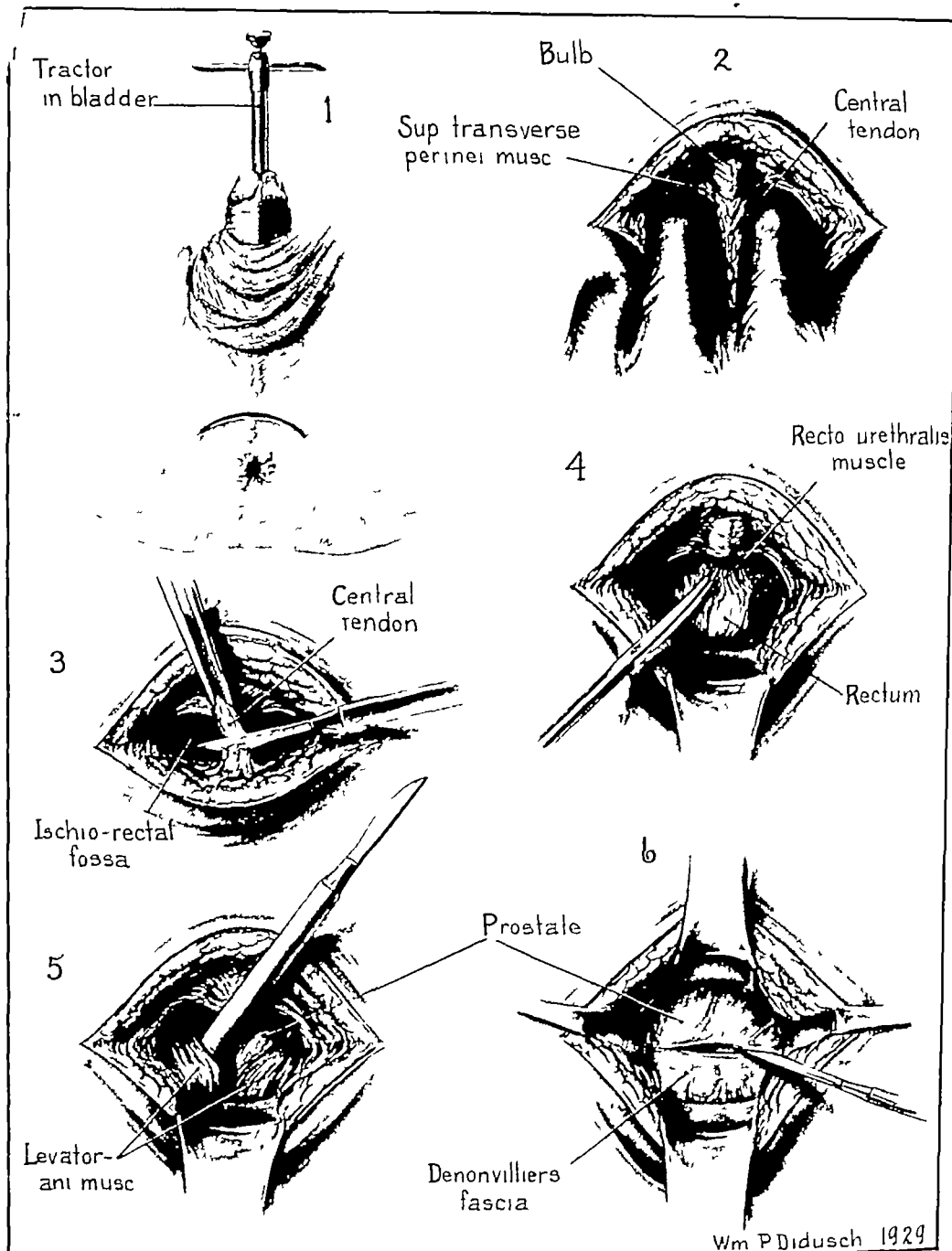


FIG 322 —Operative technique of the perineal method 1, Patient in exaggerated lithotomy position as for perineal prostatectomy, seminal vesicle urethral tractor in position. A semilunar perineal incision is made 2, Index finger in ischio-rectal fossa, gaining line of cleavage of the superficial perineal muscles by blunt dissection 3, Exposing bulb of urethra and cutting central tendon of the two ischio-rectal fossae 4, With bulb tractor in position, the recto-urethralis muscle is cut with scissors to separate the rectal attachments from the apex of the prostate 5, Method of separating by blunt dissection the levator ani muscles and the remaining fibers of the recto-urethralis muscle from its attachments to surface of the prostate 6, Exposure of glistening fascia of Denonvillier covering prostate gland, superficial transverse incision, cutting first layer of Denonvillier's aponeurosis, with bulb and deep perineal tractor in position, use of two lateral tractors for better exposure

At the beginning of this operation it is useful to introduce the long urethral seminal vesicle tractor to bringing the prostate into view and hold it there during the operation. The bladder should be filled with a mild antiseptic solution such as boric acid in order to furnish a more resistant plane in the anatomical dissection and thus facilitate a good exposure. This helps to establish the proper plane of cleavage at the time of the enucleation of the vesicles and makes it easier to accomplish the separation of the vesicles from the ampulla. If there is any oozing hot compresses may be used to keep the operative field clean. No actual hemorrhage or shock is encountered.

Special care should be taken to keep away from the rectum when cutting the recto-urethralis muscle otherwise a rectal fistula may result. In some cases it is advisable to be guided by the left index finger in the rectum.

Although the membranous urethra is exposed during this operation incontinence of urine has never occurred in the author's cases since the urethra is not opened and neither sphincter is cut.

In the *postoperative care* the stitches are removed about the sixth day and the patient remains in bed for ten or twelve days. If oozing or bleeding has made it necessary to employ gauze pads these may be removed together with the cigarette drain on the third or fourth day after operation. At this time every patient receives an ounce of castor oil and an enema.

Young's Radical Procedure — For the surgical treatment of tuberculosis of the seminal vesicles Young⁶ conceived the radical operation of excision of the entire spermatic tract. (See Chapter XIV.)

The Ischiorectal (Voelcker's¹²) Method. This method designed to avoid the difficulties of recto-urethral stripping consists of four main points:

1. A lateral incision is made beginning at the mid-line 2 finger breadths in front of the anus curving inward to pass at mid-distance between the anus and the ischium and terminating in the mid line near the base of the coccyx or higher up as far as the fourth sacral vertebra. If it is desired to have a single incision give access to both seminal vesicles the incision should be made on the left side.

2. The ischiorectal fossa is traversed the levator ani discovered and widely exposed the latter is then incised longitudinally to permit entrance into the superior pelvicorectal space. The bottom of the wound is thus constituted by the deep perineal aponeurosis which conceals the pelvic organ this must be incised parallel to the long axis of the rectum upon the anterior margin of that organ. This leads into the interprostatorectal space.

3. This space is split with the finger the rectum pushed back and the prostatovesicular region exposed in the bottom of the wound. After incision of Denonvillier's aponeurosis the vesicles come into view.

4. It remains only to isolate the vesicles remembering that their vascular pedicle runs along their external margin. This should

structed prostatofascial layers of Denonvilliers' aponeurosis. The two levator ani muscles are drawn together with two separate deep sutures of chromic catgut, thus closing the floor of the pelvis and leaving the

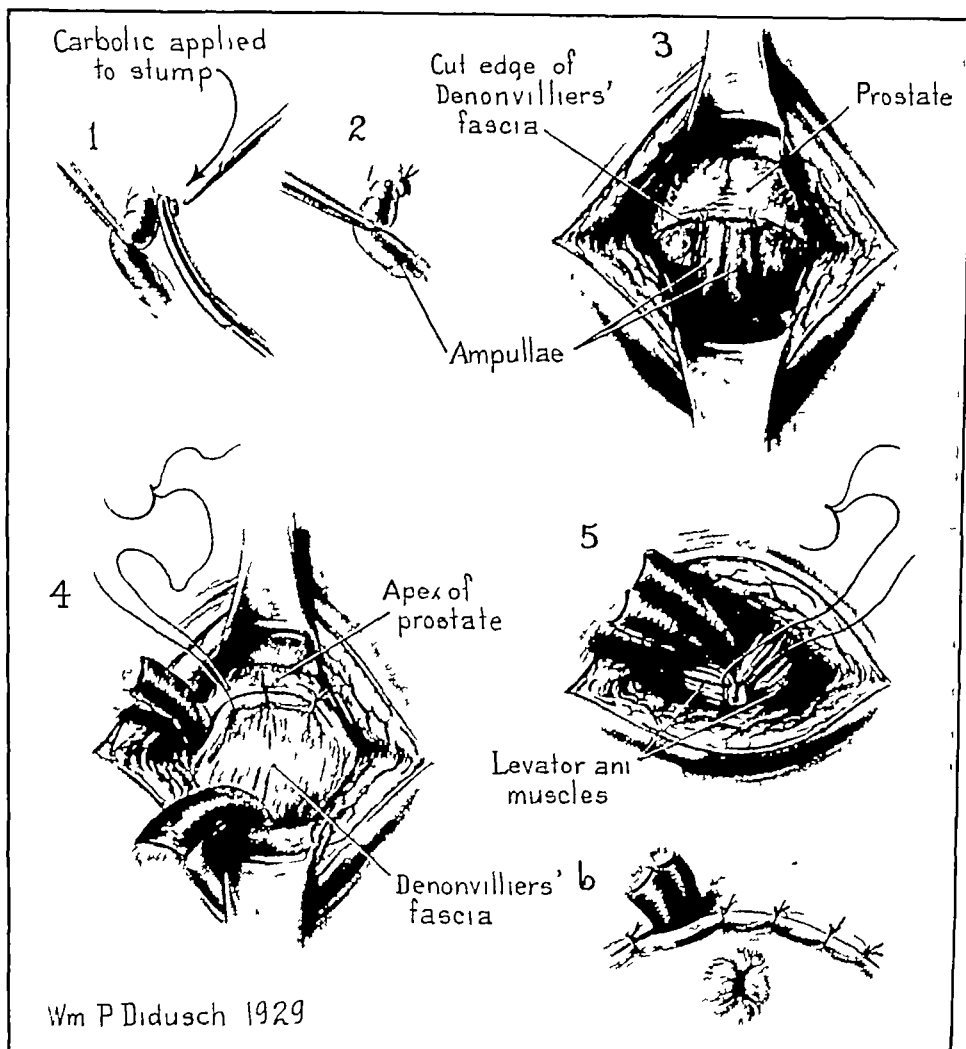


FIG 324—Operative technique of the perineal method. 1, Method of applying phenol, following alcohol, to stump of ampulla. 2, Ligature after vesicle has been excised, with normal integrity of remaining ampulla. 3, Bulb and perineal tractor in position, showing complete and most satisfactory view of the operating field and the patency of the two ampullae of the vasa deferentia remaining after seminal vesicles have been removed. 4, Method of suturing fascia of Denonvilliers' aponeurosis to secure perfect healing; reconstruction of this anatomical structure is of paramount importance. A small cigarette drain is placed at the base of the prostate, and another behind the reconstructed fascial plane deep in the perineum. 5, Reconstruction of the perineum, bringing the two levator ani muscles together by two deep sutures, cigarette drains brought to one side. 6, Closure of wound with interrupted silk-worm-gut, leaving cigarette drains in place.

cigarette drains in place, as in Fig 324-5 and 6. The wound is then closed by bringing the two edges of the skin together by interrupted sutures of silk-worm gut. As a rule there is no bleeding nor any other complication, and the wound heals firmly in about two weeks.

times for prostatic tumors and all are in agreement as to the severity of the procedure. Pauchet however had only 1 death in 5 cases. The great danger lies in hemorrhage occurring either immediately after operation or later, also in surgical shock and in the risk of pelvic infection and rectovesical fistula.

Thomson Walker's Technique In simple cases of vesiculitis Thomson Walker¹⁹ who in 1924 reported a series of cases of vesiculitis proposed a transtrigonal vesiculectomy. He does a wide cystotomy and then places a vesical retractor giving a wide exposure of the trigone. The bladder wall is incised at the level of the trigone in the shape of an inverted letter T, the vertical branch of which is in the axis of the trigone while the horizontal branch 2 cm. long passes immediately



FIG. 325

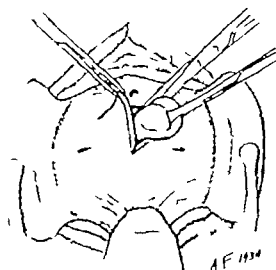


FIG. 326

FIGS. 325 and 326. The transtrigonal method of approach to the seminal vesicles.

FIG. 325. With the bladder open as in an ordinary cystostomy an inverted T-shaped incision is made in the area of the trigone in order to expose the seminal vesicles in the retrovesical space.

FIG. 326. The left seminal vesicle is exposed, inserted free, clamped and incised for the purpose of accomplishing vesiculectomy or calculotomy, as may be indicated. This method described by Thomson Walker has been employed with certain modifications by Marion Pauchet and others in cases of carcinoma of the prostate and seminal vesicles.

behind the urethral orifice. This creates two triangular flaps upon the lifting up of which the seminal vesicles are disclosed (Figs. 325 and 326). The vesicles are seized with forceps fixed and then gently isolated with the points of curved scissors. They are then resected along with the portion of prostate adherent to them. The wound is packed or a suture of the flaps is done. Thompson Walker is well pleased with this operation, claiming that it is the most direct approach to the vesicles, that it does not expose the rectal wall to trauma and that it respects the external sphincter. There are others however among them Chaudano²¹ who point out the danger of infection passing from the vesicular bed into the pelvic spaces since this bed is at the lowest point and is not well drained.

therefore, be the last point isolated, to avoid being handicapped by bleeding

In difficult cases Voelcker advises, that the exposure be improved by disarticulating or resecting the coccyx, which brings us to Fiolle's⁶⁹ operation, to be described later (See page 639)

It is possible to combine Voelcker's method with the perineal procedure by prolonging the incision by a semi-circumference which, concave on its posterior aspect, surrounds the anus completely and even passes behind it to the ischium of the opposite side

This method of Voelcker's, although none too easy of execution, is applicable in treatment of unilateral genital tuberculosis, since it is the only one that permits the extirpation of a solitary focus at a single sitting

The Suprapubic Method (Young,⁷⁰ 1900) — This procedure removes the vesicles by a single median incision, and is a subumbilical and subserous laparotomy. The incision reaches the lesions by passing around the lateral walls, and then around the posterior wall, of the bladder, which are stripped of their peritoneum. Although the bladder is systematically opened, the vesiculectomy cannot be called transvesical. Young's⁷⁰ technique is essentially as follows

A median laparotomy incision is made from umbilicus to pubes, scrupulously sparing the peritoneum. A transverse T-shaped incision is made immediately below the umbilicus. This may involve the recti muscles more or less deeply, or may even divide them altogether

The anterior aspect of the bladder is opened, the organ explored, and catheters inserted in the ureters to avoid wounding them. The bladder wall is held taut while the peritoneum is separated from its posterior surface as far as the bottom of Douglas' cul-de-sac. This may be rather difficult

The vesicles are exposed and isolated successively behind the bladder wall, and the vasa deferentia also, borne along by the peritoneum, to which they remain adherent. Both the vesicles and the vasa are widely resected and, if necessary, the diseased base of the prostate as well. Excision of portions of the diseased bladder follows in cases where tuberculous lesions have been transmitted to this organ, after which the wound is closed and drained

If there are vasotesticular lesions to be extirpated, these are reached by two independent inguinoscrotal incisions

This laborious operation, which has been known to require two and a half hours, constitutes for patients in poor condition a very grave traumatism almost beyond their endurance. Legueu⁷¹ and other European surgeons have also tried this suprapubic or inguinal method, but they regard it with little enthusiasm, owing to the difficulties of the surgical exposure and the impossibility of providing proper drainage, the procedure being followed in some instances by suprapubic fistulas and even pelvic cellulitis

The Transvesical Method — This technique has been employed by Marion,⁷² Pauchet,⁴² Thomson Walker,¹⁵ and others. It is used at

this mode of approach made certain changes in the technique which resulted in a method which they described as follows (Fig. 327)

With the patient in the Trendelenburg position, an incision is made from the middle of the frontal aspect of the scrotum up to the inguinal ring following the crural arch in a line parallel to and 1 inch above it as far as the antero-posterior spine over which it curves backward. The epididymis and testis are removed and the cord freed up to the

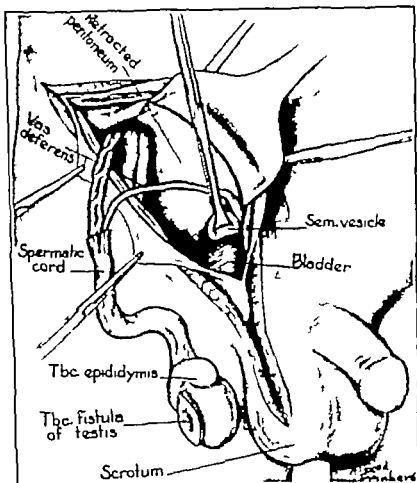


FIG 327.—Inguino-abdominal radical method of Villeneuve for total unilateral removal of the spermatic tract including epididymis and testis, for tuberculous. In this method, the testis may be saved when not tuberculous, removing only the tuberculous epididymis, vas, ampulla and seminal vesicle (epididymo-vaso-ampullo-vesiculectomy). This type of procedure has been used and modified by Bau let and Duval, Leguen, Vilard and others.

inguinal canal. This is opened for its entire length as if for ligation of the external iliac. The transversalis fascia is opened and the epigastric artery tied if necessary. The peritoneum is stripped off keeping close to the serosa. By maintaining this close contact the operator does not lose his landmarks in the maze of branches of the hypogastric along the ureter, but he must bear in mind the possibility of wounding the bladder vessels or the ureter. Within the pelvis the work grows difficult, the exposure is poor, the wound deep and narrow. Under

Transvesical Prostatovesiculectomy—In applying the transvesical method to malignant conditions of the prostate and seminal vesicles, Marion⁷² and also Pauchet,⁴² who praise the method enthusiastically, incise the bladder mucosa upon the circumference of the prostatic protrusion. The latter is then grasped with a tenaculum and, after methodical liberation with the finger of its anterior and lateral aspects as far as the membranous urethra, is seized and lifted up. The posterior aspect of the prostate, together with both seminal vesicles and their ampullæ, is freed, first from below upward, then from above downward, and the entire mass isolated *en bloc*, until it is held only by the vasa and a tiny vascular pedicle. These are tied and sectioned, after which hemostasis and tampons are required for the profuse bleeding of the prostatic bed and the bladder wall. Notwithstanding Marion's enthusiasm for this method, he admits that, in some of the cases, the removal of the vesicles was accomplished with the greatest possible difficulty, proving to be all but impossible.⁷²

Combined Cysto-prostato-vesiculectomy for Cancer.—In certain cases of infiltrating carcinoma of the bladder, involving the prostate and seminal vesicles, the operative procedure should be the combined method of total removal of all these organs. The success of this formidable operation depends upon the preliminary preparation of the patient by the derivation of the urine either by bilateral nephrostomy, ureterostomy or transplantation of the ureters into the bowel, and also upon securing perfect hemostasis and a good drainage of the cavity remaining after the operation has been completed. This operation has been performed since the time of Bardenheuer, Kuster and Pawlick (1887-1891). The original technique has been modified by Albarran,²³ Beer,⁷⁴ Federoff,⁷⁵ Marion⁷² and others.⁷⁶ Most of these surgeons make use of a combined abdomino-perineal method in two stages. In the first stage the prostate and seminal vesicles are exposed and liberated through the perineum and the membranous urethra is cut at the apex of the prostate, leaving in place a good sized rubber tube drainage, which will also serve later to guide the surgeon and protect the rectum from injury. The second stage of the operation is then accomplished by the suprapubic method of extraperitoneal exposure of the bladder, together with the prostate, seminal vesicles, ampullæ and the upper part of the vasa deferentia as well as the lower portion of both ureters, which have been previously sectioned. All these are then removed *en bloc*, thus accomplishing a total combined cysto-prostato-vesiculo-ampullo-vasectomy.

The Inguinal Method of Villeneuve⁷⁷ (Vasovesiculectomy)—The first to use this method was Villeneuve in 1891. The technique, which includes the forcible evulsion of the vas from the groin, was so very imperfect and so much of the work had to be done blindly by the finger, making traction upon a vas already weakened by disease, and hence almost sure to rupture, that the method as first used has been called by Chauvin "une opération détestable." In 1901 Baudet and Duval,⁷⁸ convinced of the possibility of increasing the usefulness of

sectioned if adequate exposure is to be had it is even necessary to cut a part or all of the coccygus. The posterior aspect of the rectum is thus revealed. This must be retracted downward and freed from the fibrous adhesions to the posterior surface of the prostatico-peritoneal bed. This exposes the vesicle lying deep in the pelvis about 10 to 12 cm. below the surface. This incision gives an excellent exposure the vesicular region is in full view but the vesicles lie so deep that it is difficult to get hold of them. This method has been thoroughly discussed by Rev^t in a Paris thesis published in 1900.

The Coccygoperineal Method of Fiolle - The incision is low with its top at the level of the coccyx and its terminus in the perineal region. It is thus intermediate between the posterior and the perineal modes of approach but is properly classed among the posterior. The patient is in right lateral decubitus his rectum empty but his bladder filled with fluid to force backward the organs which must be reached. The skin incision starts vertically from the internal aspect of the left ischium becomes oblique parallel to the great sacro-sciatic ligament then crosses the median line in a horizontal direction over the sacrococcygeal articulation to terminate 2 cm. to the right of the latter. The ligaments muscles and aponeuroses are incised in the same line successively from without inward. Some of the fibers of the gluteus maximus the levator ani and the left coccygeus are cut after which the coccyx and lower sacrum are disarticulated with suitable hemostasis of the lateral sacral vessels. The deep perineal aponeurosis is carefully incised where it lies like a veil at the bottom of the wound it is held to the left side of the incision lifted up and opened the left index finger is inserted within the opening and makes it possible to follow the incision toward the median line just as the peritoneum is opened in a laparotomy. The rectum is retracted and isolated along the entire area of the operation first on its left side then on its anterior aspect. Care must be taken not to section the median hemorrhoidal artery. The posterior aspect of the prostate and vesicles is now concealed only by the thin aponeurosis of Denonvillier which is incised and separated with the finger. The vessels of the vas and vesicle are ligated. A large retractor draws down the inferior lip of the incision while another pushes back the ampulla of the rectum toward the patient's right. The vessels are clamped close to the organ provided they are readily visible if not the vesico-genital artery arising from a trunk common to it and to the median hemorrhoidal artery which has been previously recognized and which separates from the former at a point somewhat high up is followed up to its bifurcation where the vesico-deferential branch should be tied. This is an important ligature and makes it possible to finish the operation without being discommoded by the bleeding that would otherwise be inevitable. The vesicular bed is opened with the knife. The ampulla and vesicle are isolated avoiding the peritoneal cul-de-sac which covers the base of the latter after which the organs are resected and the wound is closed with a drain.

light reflected from brightly nickeled retractors, the intestine is held out of the way, and the vas, which has by this time been nearly freed, is now completely liberated and followed down to the vesicle. The latter is exposed by incision of its capsule either transversely over its fundus or longitudinally on its external border, the vesicle and vas are sectioned close to the prostate, after which the wound is closed with drainage.

Legueu's Modification of Villeneuve's Operation—Legueu⁷¹ makes his skin incision in the opposite direction, beginning over the external border of the rectus muscle. He separates the ilio pelvic peritoneum, locates and removes the vas and vesicle, and then treats the scrotal lesions by an independent incision, thus reversing the order of procedure from that of its originators.

Villard's Modification of Villeneuve's Operation—Villard⁷⁹ uses a parietal incision, starting from the upper part of the scrotum, he follows the inguinal tract to its deep orifice, and then, like Legueu, carries the incision upward again along the external border of the rectus to within two fingerbreadths of the umbilicus, after which he employs the technique of Baudet and Duval.

The Sacral Method.—The sacral approach, used by Kraske⁸⁰ for carcinoma of the rectum, was applied to vesiculectomy by Schede⁸¹ in 1893. With the patient in right lateral decubitus, a median vertical incision is made from the anus to the median portion of the sacral crest. The posterior aspect of the coccyx and sacrum is exposed, particularly the left half. The muscular insertions are detached, and the coccyx and left border of the sacrum resected, following a curved line, starting from the third groove, passing within the fourth, and terminating on the right cornu of the sacrum. The rectum is retracted toward the right, and the solid sacro-recto-genital aponeurosis is cut through, exposing the prostatovesicular region, whereupon the vesicles and ampullæ are dissected and removed.

*Rydygier's*⁸² *Modification of the Sacral Operation.*—This method involves a temporary bone resection, to be closed after the vesicle is removed. The skin incision starts at the postero-superior spine of the left ilium, and curves inward over the summit of the coccyx, to terminate at the anus. A flap of sacrococcygeal bone is then cut under the third groove of the sacrum, and is turned back to expose the pelvic cavity. The operation then proceeds as in Kraske's method, but at the end the bony flap is replaced.

The Parasacral Method—The technique was devised by Baudet and Kendridjy⁶⁸ as a substitute for the sacral approach, to avoid the disadvantages of bone resection. The patient is placed in lateral decubitus on the side opposite the vesicle that is to be removed, with thigh flexed on the pelvis. The skin is incised in a line starting from the top of the coccyx and passing obliquely upward, parallel to the margin of the sacrum, which it follows for about 10 cm. The subcutaneous fibrous tissue, the gluteus maximus and the great sacro-sciatic ligament are cut. The upper part of the levator ani must also be

sectioned if adequate exposure is to be had it is even necessary to cut a part or all of the coccygus. The posterior aspect of the rectum is thus revealed. This must be retracted downward and freed from the fibrous adhesions to the posterior surface of the prostatico-peritoneal bed. This exposes the vesicle lying deep in the pelvis about 10 to 12 cm. below the surface. This incision gives an excellent exposure the vesicular region is in full view but the vesicles lie so deep that it is difficult to get hold of them. This method has been thoroughly discussed by Rey⁴³ in a Paris thesis published in 1900.

The Coccygoperineal Method of Fiolle⁴⁴—The incision is low with its top at the level of the coccyx and its terminus in the perineal region. It is thus intermediate between the posterior and the perineal modes of approach but is properly classed among the posterior. The patient is in right lateral decubitus, his rectum empty but his bladder filled with fluid to force backward the organs which must be reached. The skin incision starts vertically from the internal aspect of the left ischium, becomes oblique parallel to the great sacro-sciatic ligament, then crosses the median line in a horizontal direction over the sacrococcygeal articulation to terminate 2 cm. to the right of the latter. The ligaments, muscles and aponeuroses are incised in the same line successively from without inward. Some of the fibers of the gluteus maximus, the levator ani and the left coccygus are cut after which the coccyx and lower sacrum are disarticulated with suitable hemostasis of the lateral sacral vessels. The deep perineal aponeurosis is carefully incised where it lies like a veil at the bottom of the wound, it is held to the left side of the incision, lifted up and opened, the left index finger is inserted within the opening and makes it possible to follow the incision toward the median line just as the peritoneum is opened in a laparotomy. The rectum is retracted and isolated along the entire area of the operation first on its left side then on its anterior aspect. Care must be taken not to section the median hemorrhoidal artery. The posterior aspect of the prostate and vesicles is now concealed only by the thin aponeurosis of Denouvillier which is incised and separated with the finger. The vessels of the vas and vesicle are ligated. A large retractor draws down the inferior lip of the incision while another pushes back the ampulla of the rectum toward the patient's right. The vessels are clamped close to the organ provided they are readily visible if not the vesico-genital artery arising from a trunk common to it and to the median hemorrhoidal artery which has been previously recognized and which separates from the former at a point somewhat high up is followed up to its bifurcation where the vesico-deferential branch should be tied. This is an important ligature and makes it possible to finish the operation without being discommoded by the bleeding that would otherwise be inevitable. The vesicular bed is opened with the knife. The ampulla and vesicle are isolated avoiding the peritoneal cul-de-sac which covers the base of the latter after which the organs are resected and the wound is closed with a drain.

The Anococcygeal Method — Hunt¹⁶ has proposed the following operation, which he has used in 5 cases. The patient, in ventral decubitus, is placed on the table with pelvis elevated, and a median rectilinear incision made from behind the anus to a point slightly above the sacrococcygeal articulation. The bone is exposed, the ano-coccygeal raphé cut, and the tip of the coccyx resected. The rectum is isolated and mobilized, separated from the sacro-coccygeal concavity and pushed laterally. The retro-prostatic region and Denonvillier's aponeurosis are identified. The vesicle, thus exposed, is easily accessible. If both vesicles require removal, the rectum is pushed over to the opposite side, and the same procedure carried out. Hunt advises leaving a cigarette drain in the wound and suturing the levatores on the median line between the two muscles. No complications of any kind have been observed following this procedure. This operation differs from the others in employing a shorter incision in the mid-line. Although it gives a less ample exposure than other posterior methods, it permits the displacing of the rectum successively to right and to left, according to the needs of the situation.

All these posterior incisions and also the perineal method have the great advantage of making it possible to reach both vesicles through a single incision, and they also allow the operator to work under full vision. This is especially true of Fiolle's operation. The perineal and posterior approaches also provide the best drainage. It is obvious that the anterior methods are faulty in this respect. The transvesical approach is particularly disadvantageous for this reason. For both tuberculous and non-tuberculous inflammation of the vesicles the perineal approach must remain the best method, permitting adequate treatment and providing sufficient drainage, with a minimum of operative risk.

OPERATIONS UPON THE AMPULLA.

Surgical operations upon the ampulla alone are rarely performed, because in very few instances will the ampulla show pathological conditions that do not also involve the seminal vesicle or the vas deferens. There are circumstances, however, in which an intervention upon the ampulla is indicated, without simultaneous operation upon the vesicle.

Ampullectomy — The surgical drainage of the ampulla by either the perineal or the inguinotubercular route finds its correct indication in those cases of acute or chronic ampullitis where the ampullæ are dilated and inflamed, and in which the multiple crypts and sacculations cannot be drained in any other way. The operation is carried out by the same type of incision and exposure as are employed for vesiculectomy. One or several incisions are then made in each ampulla for the purpose of draining the irregular cavities, which may be found full of pus and concretions. Drainage is provided by a small, soft urethral catheter attached to the border of the ampullar incision by means of a chromic catgut suture, leaving a small cigarette drain at the base of the prostate. The wound is then closed as in vesiculectomy.

Ampullectomy—Operations for the removal of an ampulla are more commonly indicated than has been suspected particularly in tuberculosis or in anomalies of the tract. We have seen in the discussion of anomalies that an ectopic ureter sometimes opens into an ampulla here in view of the fact that the kidney and ureter have lost their entire function an ampullo-ureteronephrectomy may be indicated as the author has pointed out in an article on the indications and technique of combined ureteronephrectomy.⁴⁴

The ampulla may be chronically diseased with hydatid infestation or tuberculosis and in such cases ampullectomy is properly indicated. The technique for the anatomical exposure of the ampulla is the same as that used for vesiculectomy. The ampulla is ligated as high up as possible. We have already seen that in tuberculous infection the vesicle and ampulla are nearly always both involved owing to their intimate anatomophysiological relationship hence the removal of the ampulla of the one side nearly always means the removal of the vesicle of the same side.

Ampullovessiculectomy—In tuberculosis of the spermatic tract when the lesion is primarily found in the seminal vesicles and ampullae the removal of the entire upper spermatic tract is indicated. Essentially ampullovessiculectomy consists in placing two ligatures one at the base of the prostate where the ampulla and vesicle unite to enter the prostate by a common duct and the other as high up as possible in the ampulla as at the level of the point where the ampulla crosses the ureter. The procedure may be unilateral or bilateral. If bilateral sterility is to be expected. The approach is made as in simple vesiculectomy.

Ampullovasectomy—In certain cases in which the vesicle or the epididymis has already been removed the ampulla and the stump of the vas proper may become diseased or fistulous and call for an ampullovasectomy procedure. This may be accomplished by the perineal or inguinal route of approach or by a combination of the two methods.

LATE RESULTS OF THE PERINEAL OPERATION

The late results may be summarized under two headings (a) functional and (b) anatomical.

Functional Results.—When the vesicles alone are removed under full vision and the ampullae are not torn the lumen of the vas deferens remains patent and therefore the spermatic function is not disturbed provided of course that the ejaculatory ducts are patent. The ampulla or remaining portion of the tract gradually becomes dilated after vesiculectomy and undergoes a compensatory hypertrophy so that it finally assumes part of the function of the vesicle and becomes the reservoir of the semen with the same power of expulsion during the ejaculation that was previously exercised by the vesicle. This it can do because from the beginning it has the same anatomical disposition as the seminal vesicle itself and when the vesicle becomes diseased or obliterated, or is

excised surgically, the ampulla, by its own normal physiological process, becomes capable of replacing the vesicle and of performing vicariously the functions proper to the latter. Hence the removal of both seminal vesicles for the relief of chronic vesiculitis does not alter either the genital integrity or the spermatic function. This has been fully demonstrated in the author's series of 100 vesiculectomies reported in 1928.

It is worthy of special emphasis that not a single case of urinary incontinence has been observed in the author's series. The urinary control should be perfect after properly executed perineal vesiculectomy.

Anatomical Results —Patients examined five or six years after vesiculectomy (without ampullectomy) have exhibited the following results.

The external genitals remain normal, or the same as before operation, in practically all cases. The scar of the perineal wound is seen to be firmly healed. In about 10 per cent of cases slightly hypertrophied or adenomatous prostates have been found, but no urinary symptoms have been present even in these cases. In about 80 per cent of cases rectal examination shows the prostate to be normal in size and consistency. A very few cases reveal a boggy prostate with adhesions or rectal attachment. In about 5 per cent of cases a peculiar fibrotic band of tissues has been found at the base of the prostate, running from the right to the left of the median line. It is probable that this band is the remains of the layers of Denonvillier's fascia which were left loose in the recto-vesical space. These bands are of no particular significance except that they make palpation of the ampullæ impossible, and thus show the importance of preserving all layers of fascia. These should be reconstructed and sutured in a proper way, just as in any other operation.

Common Complications that may Follow Poorly Executed Operations.—Among complications easily arising as the result of faulty operative measures upon the seminal vesicles may be mentioned *peritonitis*, *pelvic cellulitis*, *ischio-rectal abscess*, *prostatitis*, *ureteritis*, *cystitis*, *vasitis* (*deferentitis*), *epididymitis*, *epididymo-orchitis*, *perineal fistula*, *rectal fistula*, *rectovesical fistula* and *urinary incontinence*. Where there is poor exposure or inadequate provision for drainage, there is every opportunity for surgical accident resulting in one or more of these complications. Transvesical vesiculectomy offers conditions easily culminating in cystitis or vesical fistula. Improper care of the rectal wall invites rectal fistulas. The absence of free drainage in a downward direction readily leads to spread of infection after many of the procedures here described, which may cause any of the conditions just mentioned, or may result in abscess formation with perineal fistula. Because of these possible complications, the author is convinced of the advantages of perineal vesiculectomy in chronic vesiculitis, as well as in tuberculosis and other surgical conditions calling for extirpation of the seminal vesicles.

Vesiculectomy After Vesiculotomy —In some instances indications may exist for the total removal of the seminal vesicles after some type of palliative operation previously performed. Whenever symptoms

of chronic vesiculitis with urinary disturbances persist after drainage without any resulting relief the surgeon is justified in advising a total removal of both vesicles. Recently the author had occasion to operate upon a long-standing case of this kind in which an ischio-rectal vesiculectomy had been performed twenty years before after which however the patient had continued to suffer with so-called incurable prostatovesiculitis. He was a man in the early fifties and had for many years been visiting various genito-urinary clinics, where he had been receiving routine urological treatment for his chronic vesiculitis but without benefit. Upon rectal examination the vesicles inflamed and swollen could be palpated as an irregular mass densely adherent to Denonvillier's aponeurosis. They could not be emptied by stripping and such secretion as was obtained revealed over 40 pus cells per high power field. In this patient I carried out a perineal seminal vesiculectomy on both sides with the result that he is today entirely free from symptoms and is able to lead a normal life.

The technique for this secondary operation on the vesicles is the same as that for the primary perineal procedure already described (see page 628) except that like any other secondary surgical procedure it is more difficult and laborious on account of the many additional adhesions and scar tissue that have formed around the vesicles and between the bladder and the rectum. These greater difficulties of execution make it apparent that in the majority of cases where chronic vesiculitis is well established the wiser course is to do a primary vesiculectomy without resorting first to a drainage operation which owing to the convoluted anatomical structure of the vesicles is at best of doubtful benefit and is doomed in a large percentage of cases to complete failure as a means of bringing about the anticipated relief.

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CHAPTER XVIII

SECTION I

PROSTATIC OBSTRUCTIONS

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THE term "prostatic obstruction" is very wide in its scope, and varied in the etiological and pathological factors which are present. As a rule, when one speaks of prostatic obstruction he thinks primarily of the hypertrophied or enlarged prostate, very commonly called the adenomatous prostate. This condition is undoubtedly responsible for the great majority of obstructions to urination. There are many cases of prostatic obstruction, however, in which there is no adenoma or isolated areas of hypertrophy of the gland. Among these may be mentioned contractures at the vesical orifice, bars, posterior and occasionally anterior, general fibrosis of the prostate, cysts, carcinoma, sarcoma, tuberculosis, infections and infestations, prostatitis, prostatic abscess, calculi within the prostate and within the urethra. Some of these conditions are described in detail elsewhere. Others must be referred to here, but the principal subject of discussion in this chapter is that of adenomatous hypertrophy of the prostate.

THE PATHOLOGY OF PROSTATIC OBSTRUCTION

Benign Adenomatous Hypertrophy or Enlargement of the Prostate

—This condition comprises the great majority of cases in which there is obstruction to the free outflow of urine during micturition. It is produced by lobules of gland tissue which show great activity of the epithelial cells within the acini. It begins first as small, isolated groups of glandular hyperplasia, which are easily demarcated from the rest of the prostate, eventually forming small spheroids, which in their growth have become encapsulated by the tissues which they have compressed in their growth. Other isolated centers of similar growth occur, sometimes only a few, in other cases many. These eventually impinge upon each other and develop a group capsule, and these in turn become conjointly encapsulated with other groups. We thus have the picture of a large, encapsulated lobe containing numerous smaller and larger lobules, spheroids and minute groups of conjoint

¹ This chapter was written in the last edition by Dr. James Gardner, some of whose text and illustrations have been retained.—H. H. Y.

and isolated encapsulation the whole forming a more or less rounded mass which intervenes between and pushes the normal gland tissue away from the urethra. It distorts, compresses, widens, elongates and changes the urethra and vesical orifice in many ways. The condition above described may be confined to a single portion of the prostate. The portions involved are usually the median or lateral lobes. More rarely the anterior lobe or commissure of the prostate which normally contains very few glands may be the seat of an adenomatous lobule or even large lobe. More rarely that portion of the prostatic tissue which forms a broad layer beneath the posterior capsule and is separated from the lateral masses of prostatic tissue by a more or less definite fibrous layer and which we usually call the posterior lamella but has been described by Lowrey and others as the posterior lobe is also the seat of an isolated group of adenomatous hypertrophy. The subserical and subtrigonal portions of the prostate which are also more or less isolated from the lateral prostatic masses or lobes may be the seat of similar pathological changes. As a rule the growth is multiple in its origin and the various portions ultimately coalesce or impinge upon each other so as to form a single mass.

Etiology—The etiology is obscure. In an early publication Young showed that prostatic hypertrophy or adenoma was almost entirely a disease of married men. There were very few bachelors and at that time not a single Catholic priest. Since then there have been 1 Catholic priests—2 with carcinoma and 2 with benign hypertrophy—this among about 3000 cases which came to prostatectomy. It seems to us that there is no question but that an active sexual life plays a part in the development of prostatic hypertrophy. Cichanowski insists that hypertrophy is the end result of chronic prostatitis. Jones is of much the same opinion. Our studies indicate that gonorrhea plays no part except in the fibrotic types and that unless catheterization has been carried out, the majority of cases do not show much evidence of inflammation. Undoubtedly adenomatous growths or hypertrophy occur ultimately in patients who for a long time have had chronic prostatitis but sections show that the inflammatory changes are not within the lobules of hypertrophy but generally external to them.

Normally the weight of the prostate gland gradually increases from the twentieth year at which time its average weight is about 15 grams up to the fiftieth year when it reaches its maximum normal weight viz in the neighborhood of 20 grams. At this period the functional activity begins to wane and this gland like some other glands of the body undergoes a natural atrophy corresponding to the gradual decrease of functional demand. But unfortunately this normal process does not take place in all cases for about 30 per cent show pathological changes that may give rise to obstructive symptoms and are characterized by irregular nodular enlargements of one or more of the constituent lobes.

The acute conditions in which the prostate gland becomes enlarged

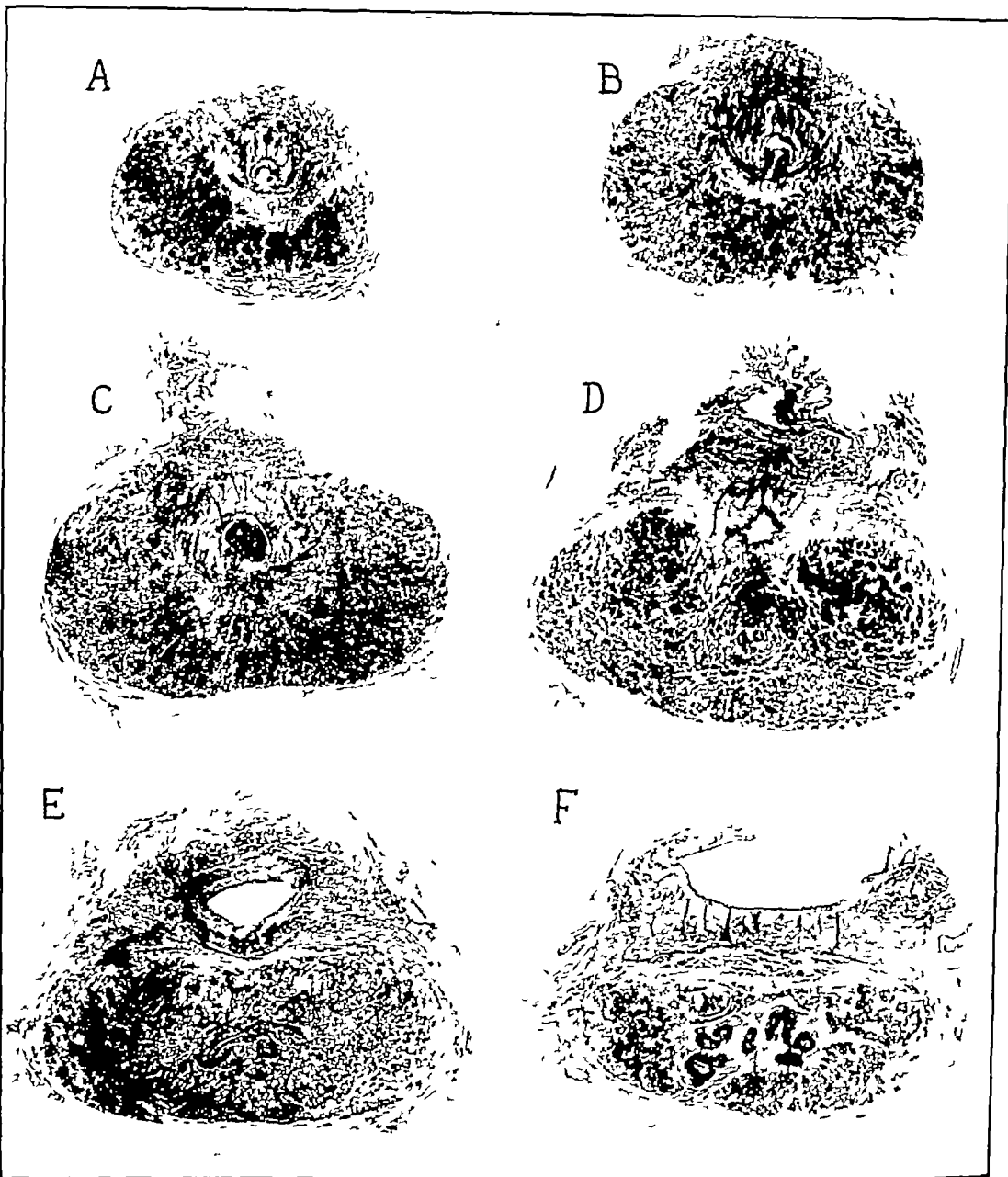


FIG 328 — Cross-section of normal prostate *A*, through apex of prostate anterior to verumontanum, showing posterior lamella extending lateralward *B*, taken immediately anterior to verumontanum showing vast extent of posterior and lateral prostatic glands. Note section of prostatic ducts emptying into lateral sulci of urethra *C*, through verumontanum showing glandular structure *D*, showing development of peri-urethral glands, urethra and ejaculatory ducts. Note musculature of internal urethral sphincter *E*, through vesical neck showing trigonal muscle and subtrigonal group of glands. Note increasing distance between urethra and ejaculatory ducts, and lessening amount of posterior and lateral prostatic gland tissue *F*, showing bladder musculature and trigone. Note ampullæ of vasa, seminal vesicles and prostatic glands at base of prostate

and thus may give rise to obstructive symptoms are acute prostatitis and prostatic abscess. These conditions will be considered in another chapter. There is considerable evidence to show that the lesion represents a hypertrophy of the perurethral glands. Lobular enlargements have been noted in specimens taken from patients dying from accidental causes in early adolescence although obstructive symptoms rarely occur before the fiftieth year. Lobule formation is absent in the normal prostate (17, 128). There is considerable evidence to show that hypertrophic changes in the prostate are intimately associated with the sex glandular system. Many investigators have shown that castration produces atrophy of the normal prostate but has little or no effect on established hypertrophy. Lower and Hicken¹ have established a relationship between the hypophysis, the testis and the prostate. By means of parabiosis experiments they showed that an excess of hypophyseal secretion developed in a castrated animal passed from the peritoneal cavity of the one to the other and stimulated the testis of the normal animal to secondarily produce hypertrophic changes in the prostatic epithelium of the normal animal. (The pathological picture is entirely different from that seen in adenomatous hypertrophy of the prostate. No spheroids, no encapsulated neoplastic lobes enucleable from within their capsules are produced but simply a general glandular increase.) They maintain that the anterior pituitary or hypophyseal secretion acts upon the prostate through the stimulation of testicular hormones. In the absence of testes the hypophyseal secretion is increased but the prostate atrophies. Enlargement of the prostate has been noted in cases of adrenal cortical tumors with hypergenitalismus.

The neoplastic theory of benign hypertrophy has been defended because of the adenomatous structure of the enlargement. Because of the rarity of infection within lobules of hypertrophy it has been argued that these portions have no ducts. Albarran and Halle as a result of a study of 100 cases recognized three varieties of hypertrophy: (1) a glandular form, (2) a fibromuscular form, and (3) a mixed form. They found only 3 cases of the fibrous form, and Motz confirmed this by finding only one in 30 cases.

The early literature was fully discussed by Young and Geraghty.² In this paper we (Y and G) described 120 specimens removed by means of prostatectomy. These show as follows: glandular 100 cases, fibromuscular 14, inflammatory 6. Under the glandular type we found the acini for the most part dilated, sometimes cystic, epithelial proliferation often in the form of stalks which sometimes grew wild within the acini. There were projections in some instances of slender pedicles of stroma while at other times only knuckles of epithelium. In the periphery we found condensation of the tissue. It was largely fibrous in character with flattened and elongated acini. In the fibromuscular type the prostatic lobule is smaller, less succulent, more

¹ Jour Urol. 31, 391 1934

Johns Hopkins Hosp. Rep. 14, 107 1900

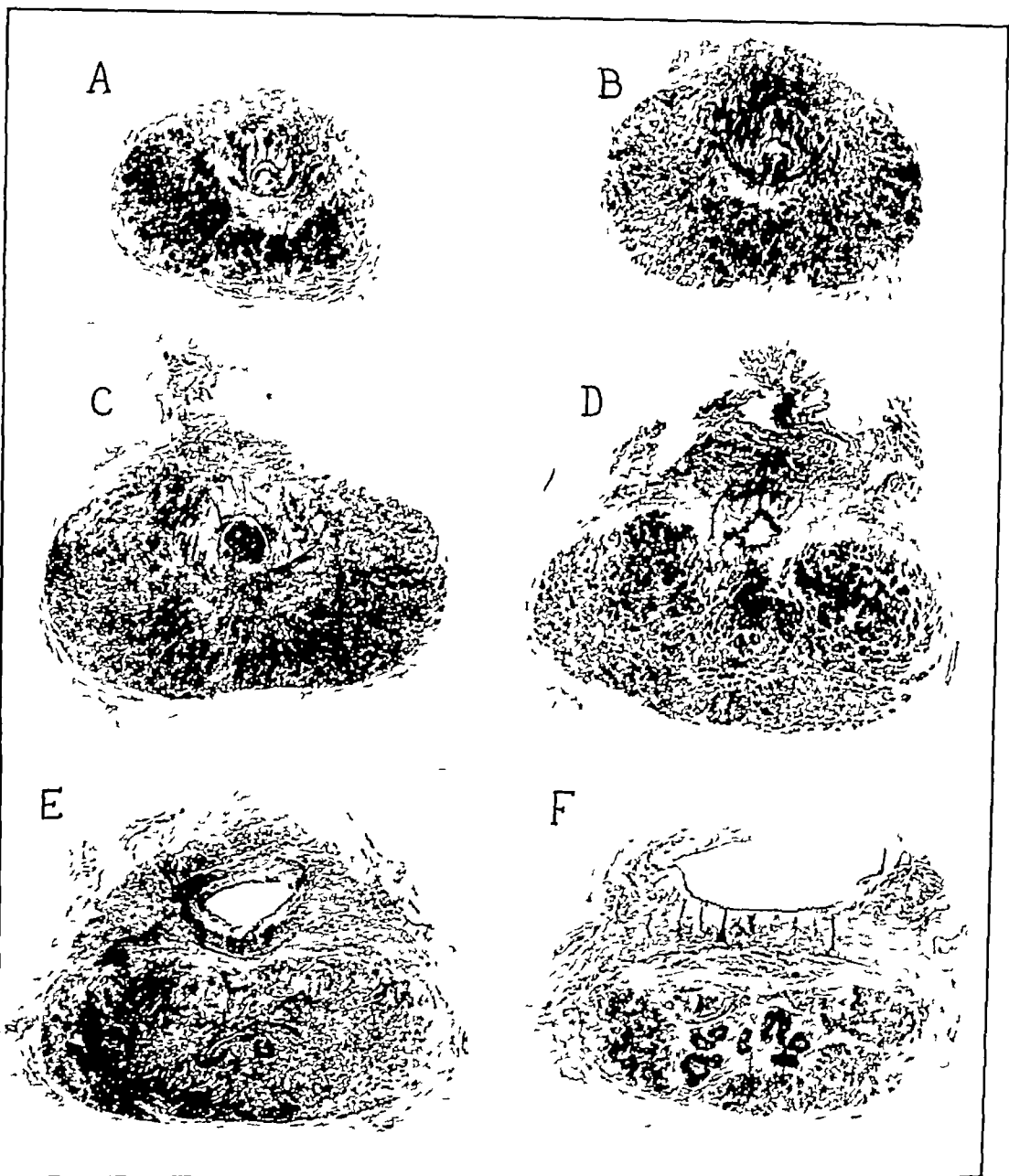


FIG 328 — Cross-section of normal prostate *A*, through apex of prostate anterior to verumontanum, showing posterior lamella extending lateralward *B*, taken immediately anterior to verumontanum showing vast extent of posterior and lateral prostatic glands. Note section of prostatic ducts emptying into lateral sulci of urethra *C*, through verumontanum showing glandular structure *D*, showing development of peri-urethral glands, urethra and ejaculatory ducts. Note musculature of internal urethral sphincter *E*, through vesical neck showing trigonal muscle and subtrigonal group of glands. Note increasing distance between urethra and ejaculatory ducts, and lessening amount of posterior and lateral prostatic gland tissue *F*, showing bladder musculature and trigone. Note ampullæ of vasa, seminal vesicles and prostatic glands at base of prostate

surrounding the prostatic ducts (Fig. 331) and abscesses. Bacteria and leukocytes are rarely found in hypertrophied lobules (Fig. 332) and there is little if any, proof that infection plays a role in the etiology of hypertrophy.



FIG. 329

FIG. 329.—Adenomatous lobe of hypertrophy of prostate. Dark areas near center represent leukocytic infiltration. B.U.I. Path. 0 10.



FIG. 330

FIG. 330.—Adenomatous hypertrophy on the right with compression of acini in the interlobar space and leukocytic infiltration. Note absence of leukocytes in cytic lobe. B.U.I. Path. 8540.

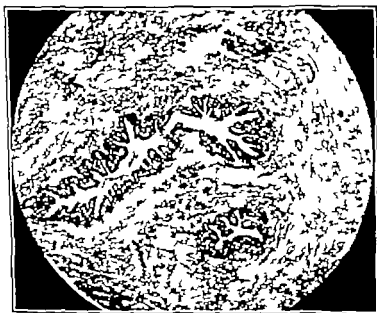


FIG. 331.—Leukocytic infiltration around prostatic ducts close to urethral lumen.

Obstruction of prostatic ducts by secretory substance or desquamatory debris may account for the dilatation of certain acini in hypertrophied lobules but we cannot accept obstruction as an etiological factor.

homogenous and although isolated spheroids are noted, they may be composed almost entirely of fibrous or fibromuscular tissue. There are signs of active gland tissue proliferation which rarely display much cystic degeneration. The muscular element often predominates in the stroma, much in excess of the gland element.

The Fibrous or Inflammatory Form of Hypertrophy — The cut surface shows no spheroids, but is homogenous and apparently fibrous. This is not true hyperplasia, but represents a type of prostatitis. Microscopic examination of the median bar in these cases always demonstrates its inflammatory nature. The lateral lobes present no changes other than those of chronic prostatitis. A review of Ciechanowski's cases shows that he was dealing with small prostates found at post-mortem examination, while ours required operation. These types are called "prostatism sans prostate" by the French School.

Our (Y and G) final statement was "prostatic hypertrophy is not a diffuse hyperplasia of all portions of the prostate, but a hyperplasia, which begins in separate foci, and results in more or less numerous spheroidal tumors. That this 'hypertrophy' always begins in the central group of glands can be readily seen by an examination of pathological specimens of early hypertrophy."

Wilson and McGrath¹ in an analysis of 468 prostates removed surgically at the Mayo Clinic, found that 387 or 83 per cent showed hypertrophy. The remaining 81 prostates showed either malignancy or tuberculosis.

Albarran and Hallé examined 100 prostates obtained from autopsies, and found 14 cases in which the lobules showed changes which suggested early malignancy, and to this they have applied the term "epithelioma adenoïde." They considered the condition malignant. In our study of 120 cases of lobes enucleated by perineal prostatectomy, there was one case in which we found a small carcinomatous nodule about 2 mm. in diameter in an otherwise benign prostate. The changes described by Albarran and Hallé have been seen by us in acini in which the intra-acinous papillary projections presented a rather wild proliferation, and showed some slight involution changes which did not justify the diagnosis of carcinoma. The microscopic picture described by Albarran and Hallé is entirely different from that found by Rich and by Moore in their recent papers on early carcinoma of the prostate.

It is our observation that adenocarcinoma of the prostate almost always has its origin outside of lobules of hypertrophy. This has recently been confirmed by Rich and by Moore.

Infection of the prostate occurs in association with hypertrophy in a large number of cases, and many patients with benign enlargement of the prostate give a history of gonococcus infection, but as it has usually occurred many years before, there is no close relation between the two. Operative specimens frequently show interlobular infiltration of leukocytes (Figs 329 and 330) and patients who have had preoperative urethral catheter drainage may have purulent material within and

¹ Surg., Gynec. and Obst., p. 647, December, 1911

group which are normally few and lie in the 'anterior commissure' may produce a lobule which projects through the internal sphincter into the bladder. It often remains intraurethral but sometimes although very rarely may form a large lobe (Fig. 335).

In a few instances we have noted at operation adenomatous hypertrophy of the posterior group of glands or lamella of gland tissue just beneath the posterior capsule and have removed lobules from the suburethral region beneath the verumontanum and posterior to the ejaculatory ducts.

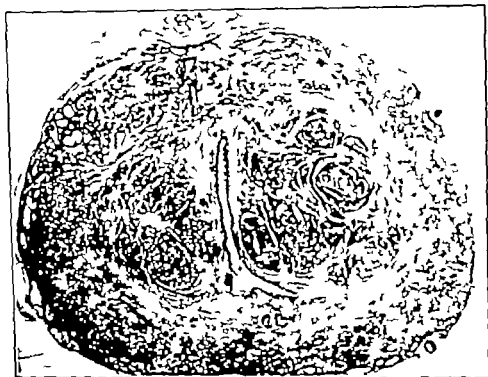


FIG. 333.—Low-power photomicrograph of a cross-section of an entire prostate gland showing multiple adenomas in the neighborhood of the urethra. Periphery shows non-adenomatous prostatic tissue. (Section kindly loaned by Dr. J. T. Geraghty.)

The majority of obstructive lesions of benign hypertrophy involve more than one group of glands. The most common type being enlargement of the laterals and postero-median group thus forming a collar around the vesical orifice (Fig. 336). In addition the glands of the trigone may be involved or a pedunculated median or subcervical lobe complicate the picture. Occasionally obstruction occurs by simple bilateral lobe hypertrophy and rarely a case of simple pedunculated median obstruction exists as the sole enlargement. Anterior hypertrophy alone rarely produces obstruction.

Hypertrophy of the lateral lobes may produce great increase in the width and thickness of the prostate as felt by rectum and commonly the prostate is elongated. Motz described a case in which the urethra was 5 cm. wide. The lateral lobes may be separated by a deep median furrow. Elongation of the prostate always occurs toward the bladder.

The Glands of the Prostate.—Loeschke¹ and Admon² divided the glands within the prostatic capsule into three groups according to their length and distribution (1) the urethral or mucosal glands, which are short and near the urethra, (2) the submucosal or suburethral glands, which are longer and more branching, (3) the postero-lateral group of true prostatic glands. Motz and Perearnau³ showed conclusively that adenomatous hypertrophy of the prostate usually occurs in the mucosal or submucosal groups. In the non-hypertrophied prostate there is no gross anatomical division between the three groups of glands. Their identity may be conjectured from their position, or proven by tracing their ducts, but microscopically they resemble each other closely. When hypertrophy occurs, a sharp division is evident between the adenomatous portion and the non-hypertrophied postero-lateral group of glands, in the form of a capsule of fibromuscular tissue (Fig 333), which has been produced by compression of tissues in the growth of the adenomatous lobule.



FIG 332 —Section of adenomatous lobule with leukocytic infiltration. Note compression of the extralobar glands. Dark areas within lobe represent leukocytic infiltration. B U I Path 8772

There are five common sites of origin of adenomatous hypertrophy. First, the two groups of submucosal glands on each side of the urethra (Fig 334, A, B, C, and D). Next, the median posterior group of submucosal glands, which Albarran called the prespermatic glands. Above them are the subcervical group of glands (Fig 334-E), which lie immediately beneath the neck of the bladder and anterior part of the trigone, and are known as Albarran's glands. Glands have been found beneath the vesical mucosa as far as the upper limits of the trigone and hypertrophy of these form subtrigonal enlargements (Figs 334-F and 336), often quite separate from the other median hypertrophies (prespermatic and subcervical—Albarran). Enlargement of the anterior

¹ München med Wchnschr, 67, 302, 1920

² Ziegler's Beitr z path Anat u allg Path, 70, 179, 1922 (Lit)

³ Ann d mal d organes génito-urin, 33, 1521 1905

with resultant displacement of the vesical orifice, trigone and seminal vesicles. The huge lobes project far above the trigone and the seminal vesicles which sometimes lie far down behind the great intravesically projecting mass. The membranous urethra is never shortened in pure hypertrophy and there is never perineal displacement but the lobes may press further down than the normal prostate. Median enlargements may present either intra- or extravasically and the size of the prostate by rectal examination may be no indication of the actual prostatic enlargement.

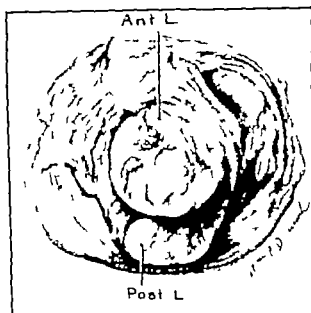


FIG. 335.—Specimen removed at perineal prostatectomy showing great intravesical enlargement of anterior lobe with less enlargement of posterior lobe. B U I Path 4503

Gross Pathology—Operative specimens of benign prostatic hypertrophy after enucleation of the adenomatous portions show well encapsulated lobes removed separately (Fig. 337) or grouped around the posterior urethra portions of which are usually removed (Fig. 338). The surface of these lobes may be regularly rounded or present small lobulations (Fig. 330). The capsule is smooth, pearly white, fibrous. The shape of these lobes varies. Lateral lobes may be round, oval or dumb-bell shaped. The latter is produced by pressure of the sphincter musculature separating the intra- and extravasical portions of the lobe. The lateral masses may be continuous with the subtrigonal median to form a collar about the urethra. The anterior and posterior commissures may both be enucleated with the hypertrophied lobes forming a complete ring about the urethra (Figs. 340 and 341). Median lobes may be pedunculated and some are of extraordinary size. Tri-lobar hypertrophy is common and the three lobes are frequently removed together (Fig. 342).

Each lobe consists of many lobules of varying size bound together by pearly white fibrous tissue. The cut surface is usually perfectly

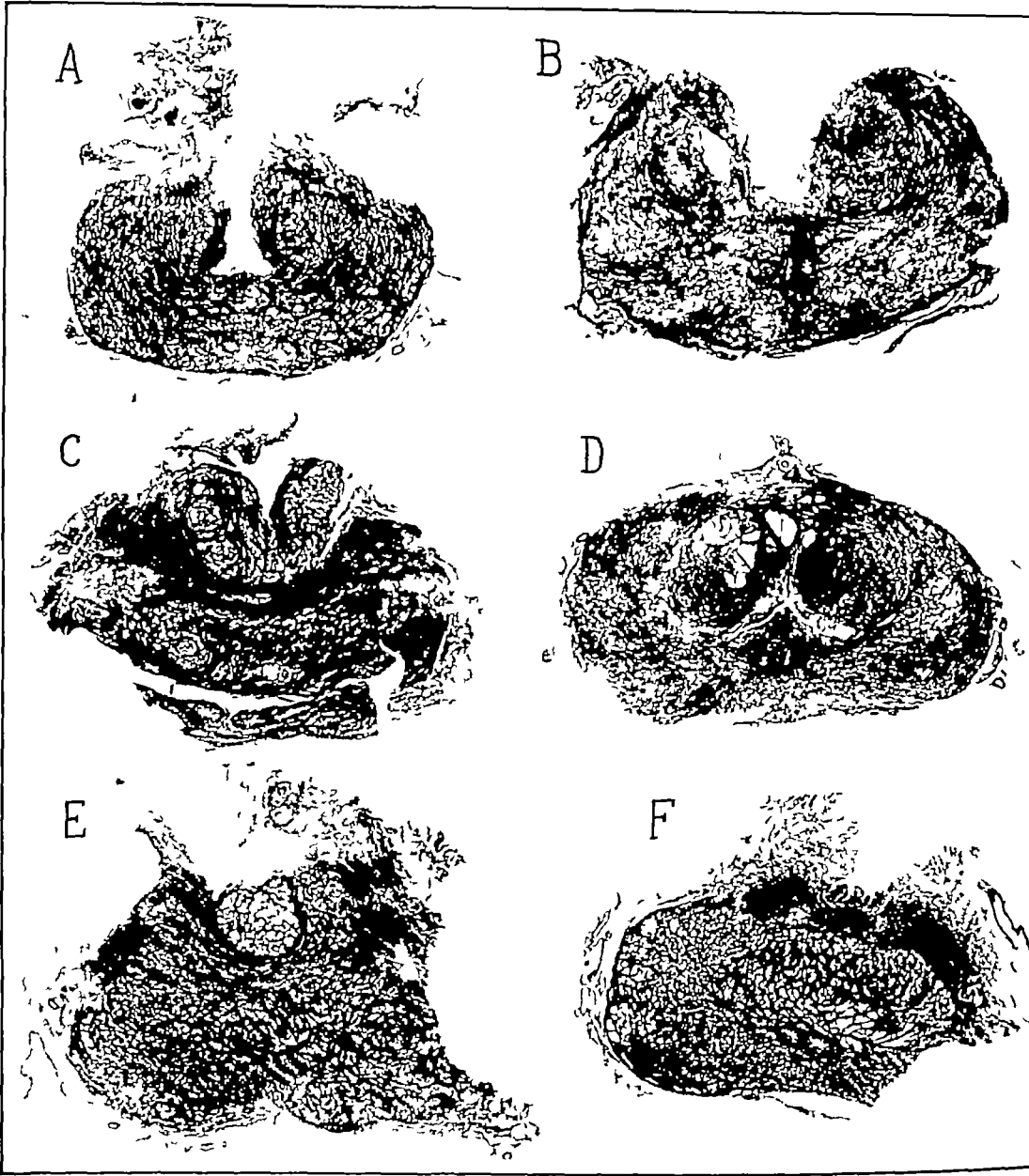


FIG. 334 —(Cross-sections of prostates removed at autopsy from five males between forty and fifty years of age, showing early adenomatous hypertrophy. *A*, early hypertrophy of peri-urethral glands without encapsulation. Note hypertrophy also of sub-urethral glands between urethra and ejaculatory ducts. *B*, encapsulation of lateral peri-urethral gland hypertrophy, no suburethral involvement. Note compression of lateral prostatic glands. *C*, adenomatous enlargement of lateral lobes. Note fibrous septum separating lobes of hypertrophy from posterior lamella. *D*, adenomatous hypertrophy with cyst formation in lateral lobes. Note encapsulation, and myoma near urethra in right lobe. *E*, subcervical lobe of hypertrophy between urethral mucosa and trigone. Note posterior hypertrophied group of glands without adenomata. *F*, adenoma formation in subtrigonal group of glands. Note position of ejaculatory ducts between adenomatous hypertrophy and posterior group of prostatic glands.

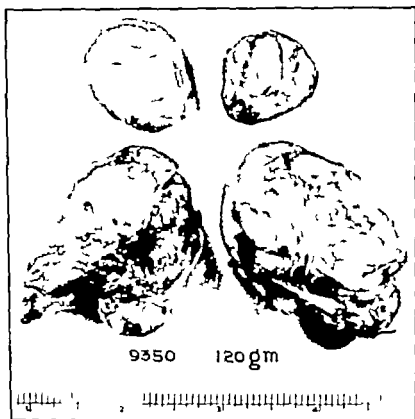


FIG. 33.—Hypertrophied lobes removed by perineal prostatectomy in four pieces. Note encapsulation and smoothness of surface of lobes.



FIG. 33b.—Hypertrophied prostate removed by perineal prostatectomy in one piece. Anterior commissure intact. Note intracapsular projecting portion of two lateral lobes, and also groove separating right lateral from median lobe.

flat without bulging of the adenomata and shows lobules of glandular tissue separated by fibrous septa. Within these lobules may be smaller lobulations, generally called spheroids (Fig 343). Cysts varying from one to several millimeters in diameter are common, and if pressure is applied, a milky secretion may be expressed. Pearly or light brown amyloid bodies may occupy acini or cysts. Actual calculi are some-

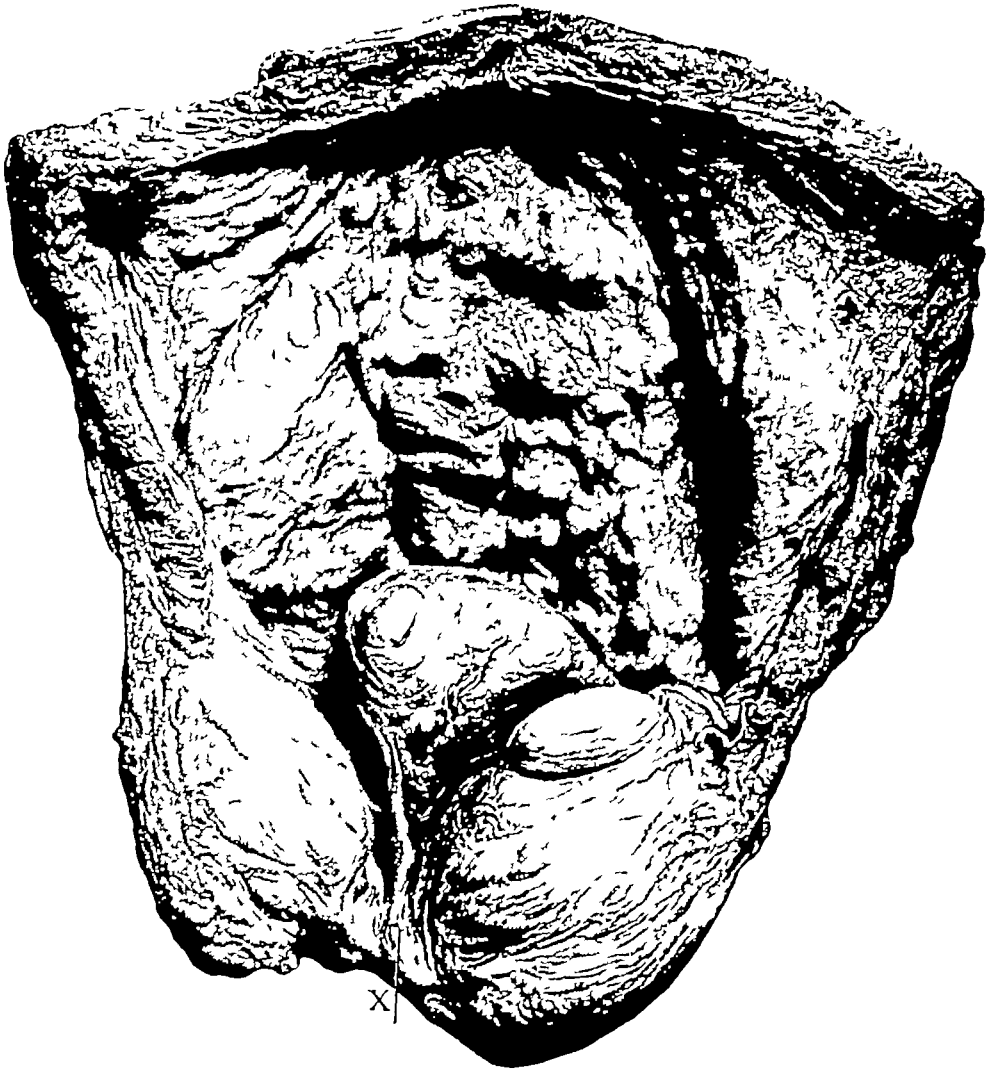


FIG 336 — Hypertrophy of both lateral and the median lobes. The Y-shape taken by the prostatic urethra as it passes on either side of the median enlargement to enter the bladder is well shown. Reduced $\frac{1}{3}$ (Watson)

times found within cystic lobules, and fine seed calculi are frequently seen in tiny acini in the false capsule or in the interlobar septa.

Microscopic Pathology.—Microscopically we find distinct lobules of glandular tissue, “spheroids,” separated by fibromuscular stroma. These glands are made up of acini lined by columnar epithelium. The epithelium of the “normal” prostate varies considerably. In young

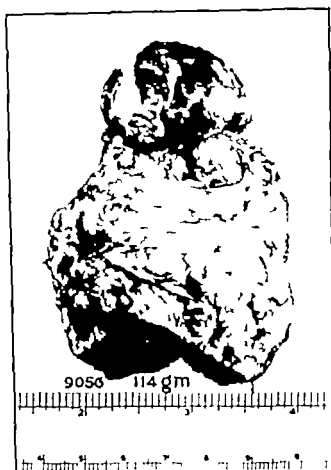


FIG. 341.—Trilobar hypertrophy removed by perineal prostatectomy with anterior and posterior commissures intact showing large intravescal projection of the median lobe

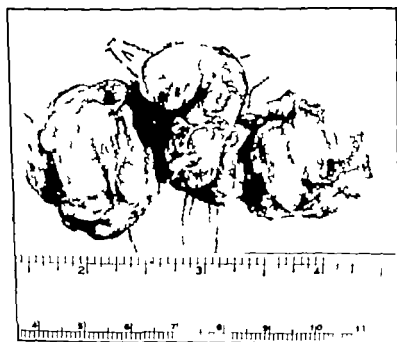


FIG. 342.—Trilobar hypertrophy removed in one piece by perineal prostatectomy. Anterior commissure not removed. Note division of median lobe produced by pressure of internal vesical sphincter

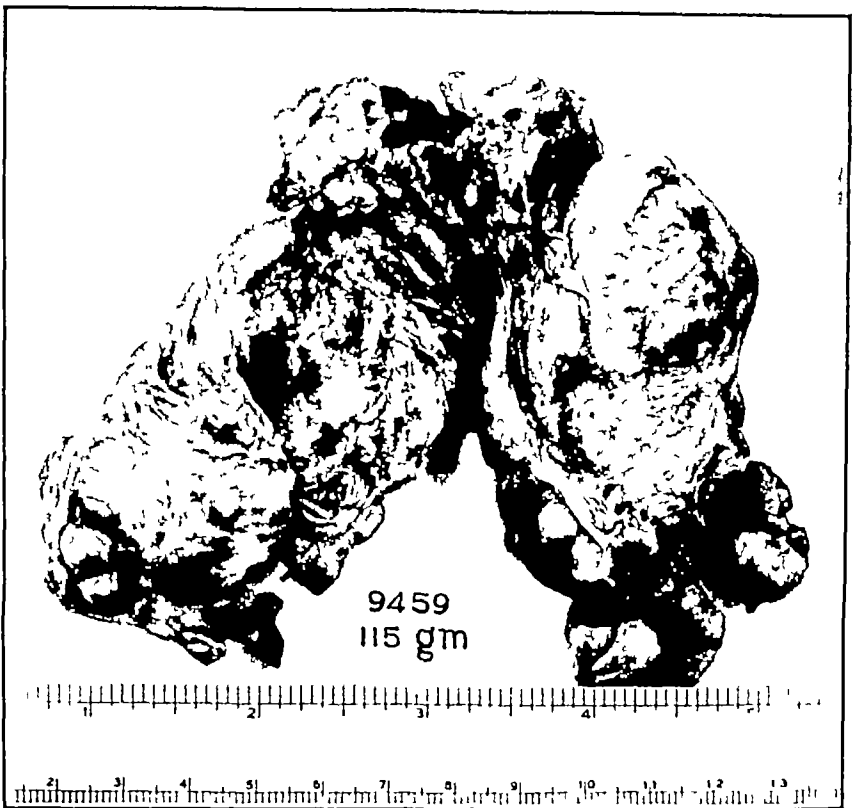


FIG 339 —Bilateral lobe hypertrophy removed by perineal prostatectomy with the posterior commissure intact Note lobulations of each lateral lobe

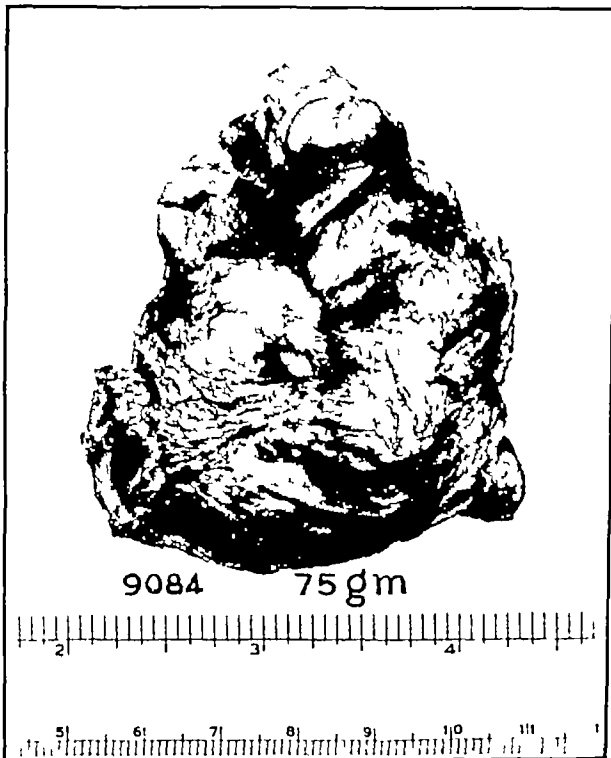


FIG 340 —Trilobar hypertrophy removed by perineal prostatectomy with anterior and posterior commissures intact Note large intravesical projection of both lateral and median lobes

in relation to the cytoplasm (Fig. 344 D). In hypertrophy the epithelium is usually cuboidal and frequently appears as a double row



FIG. 345



FIG. 346

FIG. 345.—Hypertrophied epithelium within prostatic acini thrown into folds. Note increase in fibrous stroma and leucithin bodies in one of large acini. B U I Path 9227

FIG. 346.—Marked glandular hypertrophy with epithelial hyperplasia. Note epithelial folds and villous processes within the acini. B U I Path 9131

of cells lining the acini (Fig. 344-B). The epithelium is frequently thrown into folds (Figs. 345 and 346) and villous processes project out into the acini. These processes in hypertrophy are accompanied



FIG. 347



FIG. 348

FIG. 347.—Hyperplastic epithelium and villous process within acinus of benign prostatic hypertrophy. Note fibrous tissue stalk and blood-vessels of the papilla.

FIG. 348.—Hyperplastic epithelium in acinus of benign prostatic hypertrophy. Note capillaries beneath mucous membrane. B U I Path 9134.

by a fibrous or connective-tissue stalk with blood vessels (Figs. 347 and 348). The villous projections may meet but do not fuse. Dilated

men it is usually of high columnar type (Fig 344) with small nuclei situated in the base of the cell. In atrophic prostates of the aged, the epithelium is usually of low columnar type with the nuclei large



FIG 343 —Cross-section of bilateral lobe hypertrophy with median commissure showing spheroid formation with many small cysts. B U I Path 9442

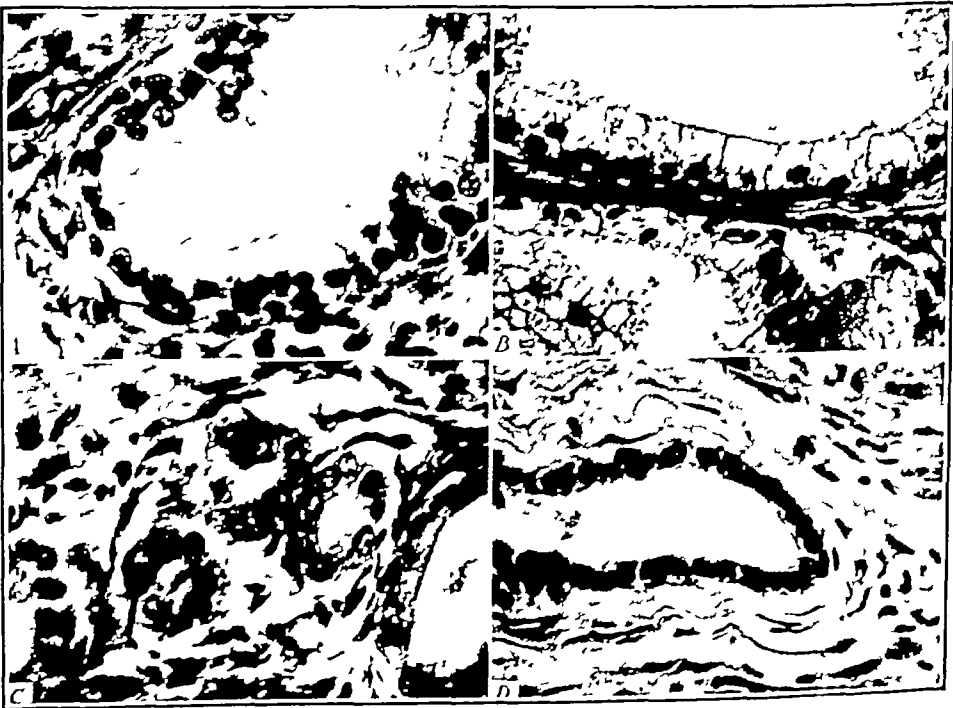


FIG 344 —Epithelial cell-types in the prostate. A, normal, B, benign enlargement, C, carcinoma, D, senile involution. (Courtesy of Dr Robert A Moore, Journal of Urology, 33, 224, 1935)

firm but elastic. This parenchymatous type of lesion seldom leads to obstructive symptoms. The microscopic picture of a high acinus simulates the picture of benign hypertrophy, but there is seemingly no increase in the number of acini; the stroma appears hyperplastic and round-cell infiltration is usually present.

Hypertrophy without lobule formation may occur in a group of suburethral glands described by Jores. These glands lie beneath the urethral mucosa between the verumontanum and vesical orifice. The effect of their enlargement is to produce a glandular median bar formation which may act in the same way as a lobular enlargement at the vesical orifice to produce obstruction. These glands are also called the presematic group.

DIFFUSE FIBROUS HYPERPLASIA

In the presence of infection the stroma of the prostate may become hyperplastic. The fibrous elements increase over the glandular and muscular tissue (Fig. 350). Usually these prostates are small, firm, very slightly compressible. The fibrous process is frequently extensive at the vesical orifice involving the internal sphincter. This fibrosclerosis of the posterior 90 degrees of the vesical sphincter forms the picture of fibrous median bar or contracture of the vesical orifice. This process



FIG. 350.—Diffuse fibrous hypertrophy of prostate. Note compressed non hypertrophied acini and great increase of fibrous element with diffuse round-cell infiltration. B.U.I. Path 9205.

may or may not be associated with benign adenomatous or diffuse hypertrophy of the prostate. It may produce symptoms of obstruction in itself by interference with the effort of the trigonal musculature to depress the floor of the urethral orifice during micturition. In simple contracture the patient presents a small, perhaps fibrous prostate by rectal examination. Cystoscopically there may be no gross anatomical change at the vesical orifice except rigidity. It may be difficult to dilate even a definite stricture. Hypertrophy of the trigone and vesical trabeculation are present sometimes in its great

acini are common and we find single or multilocular cysts lined by flattened epithelium in double or single layers (Fig. 330) The fibrous stroma varies greatly It is greatest in the presence of infection and interlobular round-celled infiltration is common (Figs 345 and 346) The acini may contain desquamated epithelium or lipid material derived from it Amyloid bodies or corpora amylacea are common These may attain considerable size and may be visible to the naked eye The larger ones are built up in layers as are many calculi They are more common in infected prostates

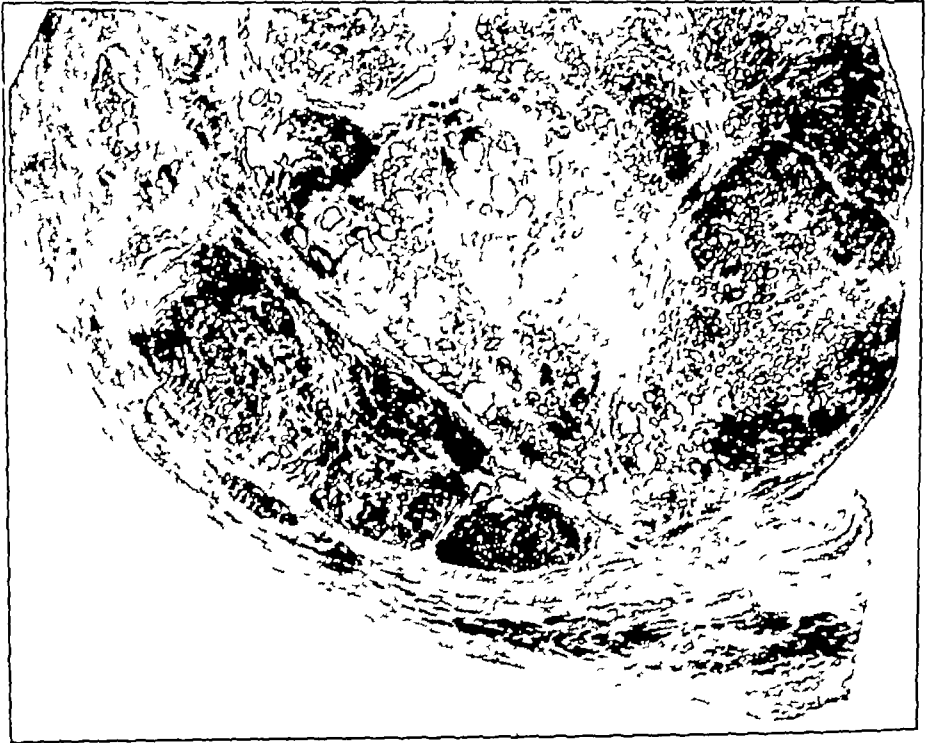


FIG 349 —Low-power photomicrograph of a cross-section of the lower left quadrant of a hypertrophied prostate Note multiple adenomata At the center the alveoli are dilated and the epithelium flattened Note small adenoma in the capsule Also atrophic remnants of prostatic glands in the capsule

The essential feature of benign prostatic hypertrophy is multilobular adenoma formation presenting hypertrophy and hyperplasia of epithelium, fusing "spheroids," with intrinsic and external capsule formation of gland tissue, which is compressed, destroyed and transformed into a fibrous capsule (pathological), Fig 349

DIFFUSE PARENCHYMATOUS HYPERPLASIA.

Diffuse hyperplasia of the prostate probably occurs as a result of infection The lesion closely resembles chronic cystic mastitis There is a diffuse hyperplasia of the epithelium of the acini without lobule or "spheroid" formation The gland is grossly little if any enlarged,

degree as in "hypertrophy." Rigidity of the floor of the vesical orifice may be observed through the cystoscope as the patient attempts to urinate.

MYOMA OF THE PROSTATE

Leiomyomata of the prostate may arise from the smooth muscle of the prostate itself or the musculature of the internal sphincter which is so intimately associated with the prostate. These tumors are usually small but by their position may give rise to obstructive symptoms. They are occasionally seen in specimens removed because of obstruction from benign hypertrophy. They may occur near the urethra adjacent to or within lobes of "hypertrophy" (Fig. 351). These benign tumors are well circumscribed firm but elastic. Microscopically they are composed of bundles of smooth muscle (Figs. 352 and 353). More frequently we find isolated nodules of fibro-muscular tissue which may be designated fibromyomata.

CARCINOMA OF THE PROSTATE

Carcinoma of the prostate is the cause of the obstruction to urination in about 20 per cent of the cases and is fully considered in another chapter. It is obvious that carcinoma can develop in any portion of the perimutlral or prostatic gland structure. It is our observation however that the usual type of adenocarcinoma of the prostate has

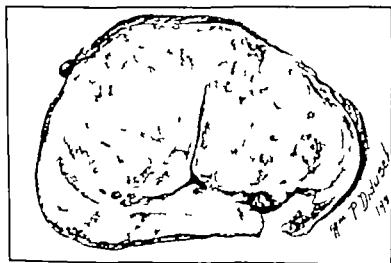


FIG. 354.—Cross-section of prostate showing adenomatous hypertrophy of lateral lobes with great widening of urethra. Carcinoma of posterior lamella of prostate without invasion of lateral lobes. Defect in posterior lamella due to biopsy. B U I Path 8800

its origin in the posterior lamella (Fig. 354) or posterior lobe (Lowsley). In Moore's series of cases of cancer which he found in routine autopsies the posterior lobe was the site of involvement in 73.5 per cent. Obstructive symptoms, therefore, should not be expected early and were it not that about 57 per cent of the cases of cancer have associated



FIG 351 —Low-power photomicrograph of a cross-section of one-half of a prostate, showing at *L* a leiomyoma, impinging on the urethra, at *A* several adenomata and at *N* atrophic prostatic tissue



FIG 352

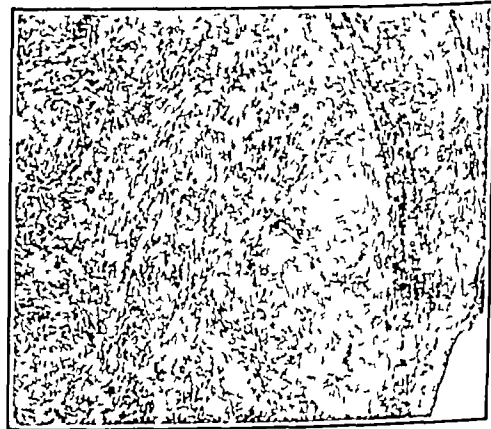


FIG 353

FIG 352 —Small myoma located within lobe of adenomatous hypertrophy B U I Path 9209

FIG 353 —Portion of adenomyoma of prostate Note capsule of myoma and compressed glandular tissue No evidence of infection B U I Path 9209

bundles contract and urine is forced outward through the orifice held open by the trigone. The bladder begins to empty the vesical muscle becomes greatly thickened and converges in rugose masses upon the trigone which remains contracted shortened thickened and elevated until the bladder muscle crowds down upon it from all sides and completes the evacuation of urine. We shall not discuss the various other muscles which are concerned in the completion of the act the emptying of the urethra (levator and the intrinsic muscles of the prostate the muscles of the triangular ligament forming the external sphincter and the muscles of the perineum and anterior urethra).

This very simple but entirely comprehensive explanation of the act of micturition has been confirmed from a neurological standpoint by the studies of Macht. In one of Young's earliest cases he describes how while viewing a small median hypertrophied lobe the patient suddenly announced that his bladder was overdistended and that he must void.

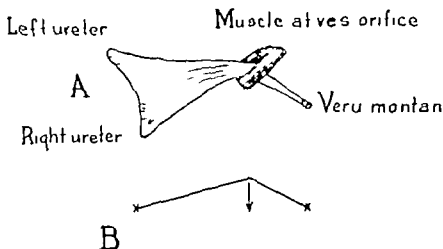


FIG. 355 — Diagram showing mechanism by which contraction of trigone opens vesical sphincter. A B resultant effect of contraction of arched trigone and its intrusion into urethra.

At that moment through the cystoscope the trigone was 'seen to contract violently and pull the median lobe backward until it almost disappeared into the tissues beneath the posterior margin of the prostate. The greatly thickened shortened elevated trigone remained in this condition as the bladder muscles went into spasmodic action and forced the urine out around the cystoscope. The effect of the trigone in pulling down the median portion and also obstructive bars and lobes and thus initiating urination has been confirmed by many observers at the Brady Urological Institute and elsewhere. It is only necessary to fill the bladder very full during cystoscopy have the patient void in order to demonstrate exactly how the trigone acts to open the vesical neck and initiate urination.

We have given the above facts in detail because it is necessary to know how micturition occurs in order to understand the effect of various types of obstruction within the prostate. In the sagittal

benign hypertrophy, many would not seek medical aid, and only those found by routine rectal examination would have the benefit of radical cure. The authors have not been able to prove that any carcinoma found in the prostate had its origin in a lobule of "adenoma." In an interesting case reported by Shaw¹ from the Brady Urological Institute, a small area of carcinoma was found within the capsule of an adenoma but lying in the compressed glandular tissue between two spheroids. We have observed areas of carcinoma within lobes of "hypertrophy" but it appears that these areas were extensions of tumor from the posterior lamella, or had their origin in non-hypertrophied acini, occurring between lobules of hypertrophy. Obstruction in these cases is most frequently produced by the coexisting lobular hypertrophy. The carcinoma may invade the entire prostate including the areas of hypertrophy and cause obstruction.

SARCOMA OF THE PROSTATE

Sarcoma of the prostate also produces obstruction to urination. It is discussed in another chapter. Theoretically fibrosarcoma, myosarcoma, myxosarcoma, angiosarcoma, round or spindle-cell, or lymphosarcoma may arise in the prostate. We have seen one case of proven sarcoma of the prostate operated upon by us, in which the tumor was entirely retrovesical, and another case, in which the large sarcomatous lobes projected into the bladder.

SECONDARY CHANGES IN THE URINARY ORGANS

The Effect of Prostatic Obstruction Upon the Bladder.—The effect upon the act of micturition by the development of these single or multiple small or large adenomata varies greatly. When even a small median lobe is present, some slight difficulty arises in the initial opening of the vesical orifice, which is necessary to allow the detrusor muscles of the bladder to force the urine out through the urethra. Young demonstrated cystoscopically and finally reported in 1917² that at the beginning of urination the trigone contracts voluntarily and pulls the median or posterior portion of the prostate downward obliquely outward (Fig. 355) thus forming a V-shaped opening into the prostatic urethra. The bladder muscle then goes into action, the muscle

¹ Jour Urol, 11, 33, 1924

² Our first published statement was "This brings up the question of the part taken by the trigone in the act of urination. It seems to me to indicate that one function of the trigone is to pull open the internal sphincter of the bladder. I have long held to this view, as I have frequently observed during cystoscopy that if violent desire to urinate came on, the trigone would contract greatly and the prostatic orifice would open widely, the median (posterior) portion being apparently drawn backward by the muscle fibers, which run from the trigone down into the posterior urethra, and which were seen to contract violently. The opening of the internal sphincter during urination will have to be viewed, therefore, not as an inhibitory action, as heretofore held, but as the result of the contraction of the powerful trigonal muscle, which passes in the form of an arc through a weaker muscle of circular shape (the vesical sphincter) and pulls it open when it contracts" (Young, Hugh H. Changes in the Trigone Due to Tuberculosis, etc., Surg., Gynec. and Obst., p. 608, 1918.)

the vesical orifice is dilated and there is no need for trigonal action so that it is not hypertrophied in fact it is atrophic. Numerous other instances could be cited to show this very important relationship between prostatic obstruction and hypertrophy of the trigone and the trabeculated muscles of the bladder.

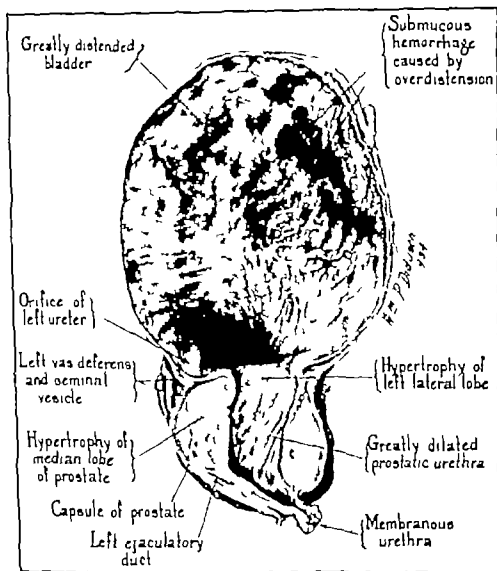


FIG. 367 — Autopsy specimen. Hypertrophy of median and lateral lobes of prostate with greatly dilated prostatic urethra. Submucous hemorrhage caused by overdistention of bladder.

At Young's suggestion Wesson made a minute study of the anatomy of the trigone, vesical neck and bladder and substantiated Young's discovery of the true physiology of micturition. He confirmed the fact that the trigonal muscle, as it passes down the urethra, forms an arc and acts to pull backward or depress the median portion of the prostate as it contracts. Wesson described a muscle on each side at the vesical orifice which acts to close the vesical orifice at the end of micturition and to

section shown in Fig 356, there is present a considerable hypertrophy of the median portion of the prostate, and moderate hypertrophy of the lateral lobes with widening of the urethra antero-posteriorly. Immediately behind the middle lobe is seen the greatly hypertrophied elevated trigone. The bladder wall is greatly thickened and the muscle bundles are enlarged, the whole forming a pronounced trabeculation with pouches, and in places cellules, which have been produced by the increasing intravesical pressure. In Fig 357, is shown a much larger "hypertrophy" of the prostate, but confined almost entirely to the lateral lobes, which have flattened the urethra, and greatly increased its posterior diameter. Posteriorly is seen a slight elevation of the

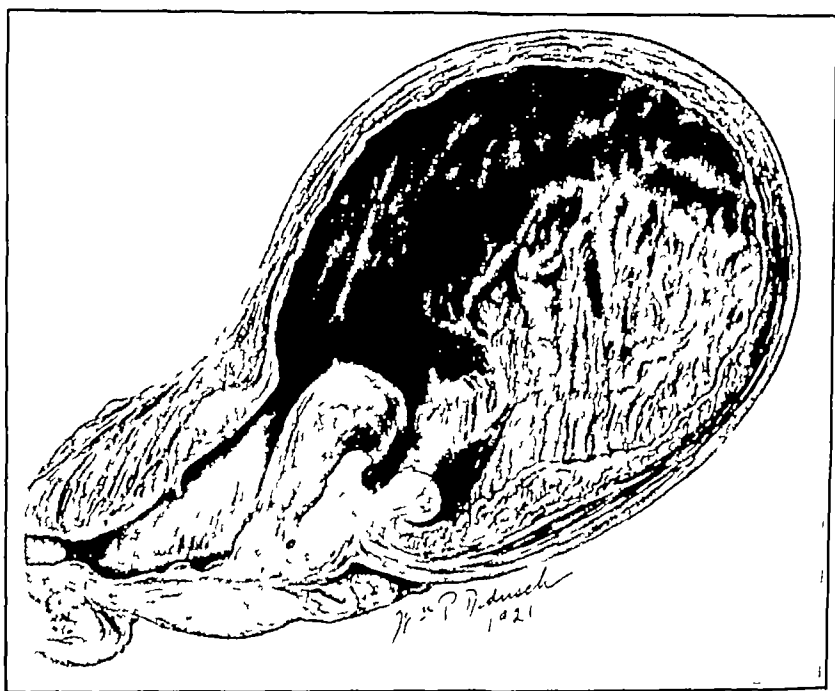


FIG 356 —Sagittal section in case of prostatic hypertrophy, with considerable enlargement of lateral and median lobes. Prostatic orifice irregularly dilated. Trigone markedly hypertrophied, with pouch behind.

prostate, but evidently not sufficient to cause obstruction, as the trigone is normal in size and shape, and the bladder muscle is not hypertrophied or trabeculated. There are no cellules or diverticula to show an increasing intravesical pressure.

Frontz and Landes¹ have shown that when the prostatic enlargement does not involve the median portion of the prostate, but consists simply of lateral lobes the trigone is not hypertrophied. Likewise, in strictures of the urethra, the trigone is not hypertrophied. In both instances there is no median obstruction to pull away in order to open the bladder for the detrusors to begin forcing the urine out. In valves of the posterior urethra, those that spring from the verumontanum in children,

¹ Jour Urol, 27, 145, 1932

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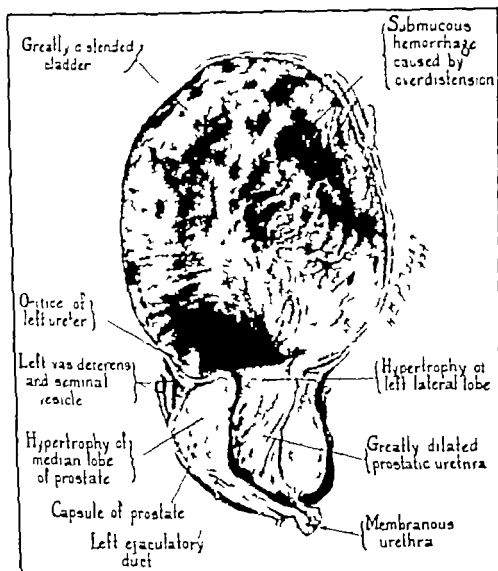


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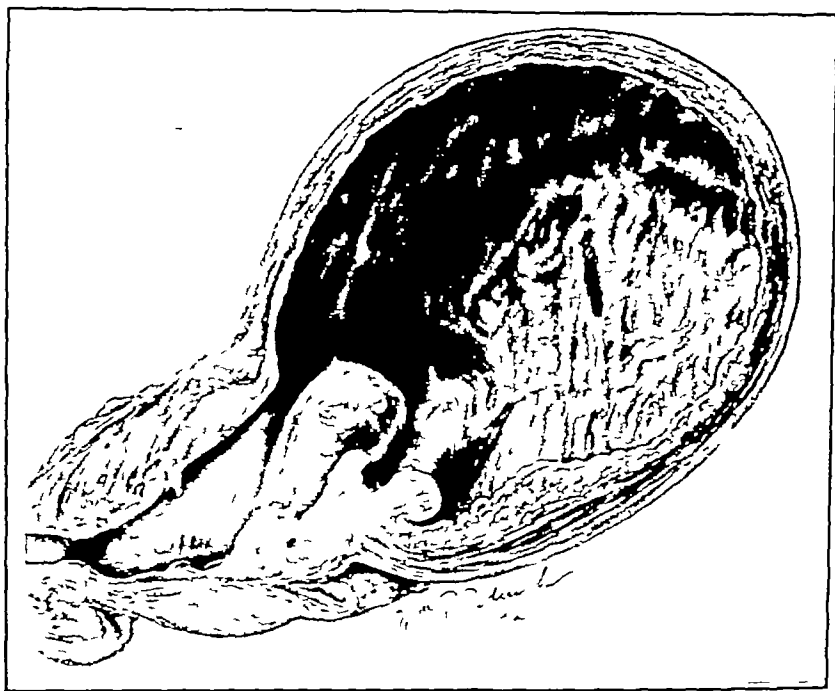


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¹ Jour Urol, 27, 145, 1932

the residual urine) and micturition is necessarily more frequent. Eventually the residual urine becomes so great and the intravesical tension so pronounced that the bladder may become dilated and finally greatly enlarged. It may even lose its tone and become much thinned out in portions. The size may increase progressively until the capacity of 1 000 2 000 4 000 and 6 000 cc. may be encountered. In one of our patients the distended bladder occupied the entire abdomen reaching the costal border. A neopax cystogram showed the bladder to be 15 inches in diameter.

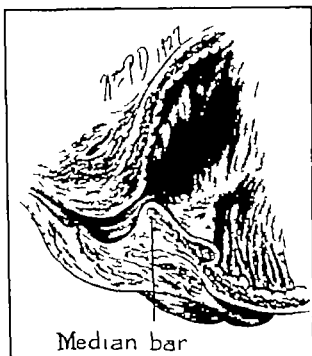


FIG. 358.—Obstructing median prostatic bar such as is seen in carcinoma of the prostate with hypertrophied trigone and trabeculated bladder.

As a rule however the bladder muscle by its hypertrophy and trabeculation resists the intravesical pressure and does not dilate but cellulæ or herniation between the bladder muscle occur and may develop into diverticula which gradually increase in size and may eventually become many times larger than the bladder itself. We have seen cases in which the diverticulum held more than 1000 cc. while the bladder was a mere appendage a thick walled sac, with a capacity of 100 cc.

Effect of Prostatic Obstruction Upon the Kidneys.—Obstruction at the vesical orifice or within the bladder may result in dilatation of the ureters pelvis infundibula and calyces and gradual compression thinning and destruction of the kidney cortex and impairment of renal function (Fig. 359). This occurs as a result of interference with the intermittent evacuation of urine from the ureters.

Bell called the trigone the sphincter of the ureters and in his first important study of the trigone showed how the contraction of the

keep it tonically closed. Young then demonstrated through a plain, tubular urethroscope that these muscles could be distinctly seen in action as the urethroscope was drawn outward from the bladder. At first one saw the triangular opening, with the muscles forming an inverted "V". As the instrument was drawn outward the median portion of the prostate (uvula vesicæ) was drawn upward until the orifice was closed. In cases of hypertrophy of the median, which formed a "U" as it was drawn upward by Wesson's lateral muscles to meet the anterior margin, the orifice forming finally an inverted crescent. If lateral lobes were present, these were seen pressing upon each other anteriorly, the median lobe being pulled away from them by the trigone as the urine escaped. At the end of the act the small median lobe was pulled upward by the lateral muscles so that the three hypertrophied masses formed an inverted "Y". In studies on pathological specimens at the Hunterian Museum, Young, in 1900, had described how the trigonal muscle often divided into two or more portions, forming deeper creases in the middle lobe as the muscle fibers pass down into the urethra, thus resulting in double or even triple lobulations. In some cases the middle lobe herniated through the trigonal muscle at the vesical orifice and projected into the bladder as a pedunculated mass. The action of the trigone, however, results in pulling this pedunculated mass away from the vesical orifice. A pedunculated middle lobe may have a ball-valve action and obstruct the outflow of urine in this manner.

The foregoing remarks demonstrate the close inter-relationship between the muscles of trigone and bladder, and pathological formations within the prostate. It is interesting to note that there is very little relationship between the amount of obstruction and the size of the prostate. In contracture of the vesical neck and in median bars (Fig 358) the prostate may even be smaller than normal, and yet the obstruction may grow progressively greater, the hypertrophy of the trigone and bladder muscle increasing, and finally, being unable to force the urine through the constricted orifice. On the other hand, very great enlargement of the prostate may develop, and the patient have little or no difficulty of urination. In many instances this is due to the absence of any median enlargement. The trigone in such cases has no difficulty in pulling down the median portion, and the detrusors, in their action, pull the lateral lobes apart, and force the urine out. Not infrequently these very great hypertrophied lobes present irregular surfaces with interstices between them, through which urine easily escapes during micturition, in fact, not infrequently it may escape involuntarily between urinations, but usually the external sphincter prevents this.

With the development of obstruction, it finally becomes impossible for the combined action of the trigonal and vesical muscles to empty the bladder. "Residual urine" develops. This may remain small, or increase steadily, in fact, rapidly. The bladder, which has usually become diminished by its muscular thickening and trabeculation, has less working capacity (actual size, or vesical capacity, minus

PLATE XII



Extreme Backward Pressure Produced by Prostatic Hypertrophy

Note extreme dilatation of both ureters and renal pelvis and extreme atrophy of renal secreting tissue. (Wade.)

trigonal muscles kept the ureters closed and acted to prevent regurgitation of the urine into them. He asserted that relaxation of this sphincter action allowed the intermittent expulsion of urine between peristaltic waves, which passed down the ureters, and its immediate closure by the trigonal muscle prevented any backflow. Although he described and illustrated how the triangular muscle was attached along the floor of the urethra, he apparently considered this only a point of fixation upon which the muscles of the trigone could pull in order to carry out their sphincteric action around the ureters. He saw no relation between the trigone and micturition, nor had other observers until our publica-



FIG. 359.—Case of prostatic hypertrophy with severe back-pressure effects—low phthalain, high blood urea. Postmortem injection of bladder with sodium iodide. Roentgen-ray showing reflux, dilated ureters, pelvis and calyces.

tion in 1918, referred to above. During the prolonged contraction necessary to pull down the obstruction in the median portion of the prostate, and allow the urine to be forced out of the bladder, the ureteral orifices are *ipso facto* closed. During this time the peristaltic waves of urine are arrested at the bladder. This results in interference with the physiological action of the ureter, accumulation of urine within it, and gradual dilatation of all structures above the uretero-vesical juncture. As micturition becomes more difficult and more frequent, and the contraction of the trigone more prolonged, the arrestation of urinary outflow from the ureters becomes more and more pronounced, and the dilatation of the upper urinary passages progressively greater (Plate XII). The ureter may eventually form a greatly dilated tube, the pelvis

become extremely large, the infundibula widely dilated and the calyces transferred from cup-like chalices to rounded sacs. *Parit passu*, the renal cortex becomes compressed and more and more thinned out until eventually it may become a mere thin-walled sac. Along with this goes progressive impairment in renal function and retention within the blood stream of products which should be eliminated.

Symptoms—The symptoms vary according to the pathological condition present. With simple benign hypertrophy, not associated with infection, the patient may go a long time without symptoms. During this period, while the prostate is growing larger, and compression upon the urethra gradually increasing, the trigone and bladder may progres-

PLATE XII



Extreme Backward Pressure Produced by Prostatic Hypertrophy

Note extreme dilatation of both ureters and renal pelvis and extreme atrophy of renal secreting tissue. (Wade.)

sively change so as to take care of the obstruction. In such cases the trigone becomes larger, more prominent, more powerful, and even though the median portion enlarges considerably, it is still able, with its increasing strength, to pull it down out of the way, so that the bladder, with its detrusor muscles, which also have become stronger, are able to empty the bladder completely. Residual urine develops in a short time in most cases, because the trigone and bladder are unable to completely evacuate the urine, but if the capacity of the bladder remains normal, or the bladder becomes dilated, the interval may still be normal. In one of our cases, which presented absolutely normal urination at normal intervals, there were 2100 cc. residual urine, but the bladder held 2600 cc., so that micturition occurred at normal intervals. The patient's only complaint was that his abdomen was constantly getting larger, and he had to buy new trousers frequently because of his increasing waist band. As a rule, however, when the bladder has to overwork, and the musculature becomes thicker and more trabeculated, gradual lessening of the bladder capacity occurs, so that with the increase of residual urine, the functioning capacity of the bladder (capacity minus residual urine) is markedly diminished. With the increase in intravesical pressure, pouches, cellulæ, and diverticula develop between the trabeculated bundles, or where the ureters and urachus pierce the bladder musculature, natural weak points. These diverticula may play an important part in the act of micturition, and as accessory reservoirs, sometimes lessen the frequency of urination.

With the development of infection, a great variety of changes in the bladder, resulting in marked variation in the symptomatology, may come on. Following the development of residual urine and infection, calculi frequently grow within the bladder, thus adding an entirely new train of symptoms. If it is a result of renal changes, polyuria develops, the overproduction of urine may also add greatly to the frequency of micturition. Keeping these facts in mind, it is easy to understand the symptoms which may be presented by cases of prostatic obstruction. In most instances the patient first notices either that he has to arise more frequently at night to urinate, or that there is hesitation at the beginning of urination. This is usually accompanied by a gradual decrease in the size and force of the stream, and may also be accompanied by some irritation or pain (local, or in the neck of the bladder, or prostatic urethra, often referred to the glans penis). In the course of time, there is apt to occur a sudden stoppage during the act of urination. This is probably due to fatigue of the trigone pulling the median obstruction downward. It is apt to come on suddenly, and be followed in a few minutes by another desire to urinate, in which a small amount of urine will be evacuated (the trigone, in the meantime, probably having gotten over its fatigue). With the gradual increase in residual urine, the frequency correspondingly increases, unless the bladder dilates, but as stated above, there is usually compensatory hypertrophy of the bladder, with reduction in capacity, so that in

creased frequency in such cases is apt to grow fairly rapidly. In a good many cases there may be no median hypertrophy or bar. In those cases the trigone is found not hypertrophied, but fairly normal in size and structure. In some cases the bladder itself has little or no trabeculation. In one of our recent cases, there were two very large lateral lobes, with a wide urethra between them, but no middle lobe, and apparently very little obstruction. The trigone was not hypertrophied, and the bladder not trabeculated. There were no cellules, no residual urine, and the bladder capacity was normal.

With the advent of infection, the symptoms may change markedly. If the infection is a descending one, coming through the blood stream, probably from the colon, *B. coli* are usually found in the urine, and often no change in the symptomatology occurs. On the other hand, if the infection is introduced with a catheter, it may be followed quickly by violent symptoms, marked inflammation, irritation, fever, chills and blood stream infection. If streptococci and staphylococci are introduced, deep seated inflammation of the bladder, ulceration, deposition of mucus, alkaline change in the urine, with the gradual development of calculi, often occur. Such infections may not stop at the bladder, but may reach the kidneys, either through the blood stream or by ascending infection, or even by the lymphatics. Pyelonephritis results with a varying train of symptoms, depending upon the extent of pathological processes engendered. In the majority of cases, in which infection does not occur, there is simply a gradual development of hesitation, difficulty, smallness of stream, increased frequency of urination, with or without pain, and discomfort. As this goes on, back pressure effects upon the kidneys may produce a gradual impairment, with concomitant uremic symptoms, at first slight loss of appetite perhaps a little nausea, occasionally headache and dizziness, later more pronounced symptoms, finally definite uremia, which may become very pronounced and even fatal.

The symptoms due to renal changes are among the most important which accompany prostatic obstruction. A gradual dilation of the ureters, pelves and calyces appears in some cases fairly early. This is probably due at first to increased frequency of contraction of the trigone required to open the vesical orifice, and initiate urination, which, as remarked above, occurs with gradually increasing frequency. When the trigone contracts and pulls open the vesical orifice, the ureters are compressed, arresting the emission of urine from the ureter into the bladder. This stoppage of the peristaltic wave continues until the contracture or spasm of the trigone releases the ureteral orifices. This obstruction to the free outflow of urine, carried down by peristaltic waves, increases in frequency and in the length of time, so that ureteral peristalsis is considerably interfered with. Stasis for longer periods results and the urine, backing up but continually forced down from above, has the effect of dilating the ureter and the waterways above. With the dilation of the pelvis and calyces, thinning of the renal cortex occurs, and impairment of function eventually results. This is characterized at first by slowing of the appearance

time of the phthalein, and the amount put out in the first thirty minutes and later by the increase in the blood of urea and other nitrogenous products. With this renal impairment there comes a gradual development of uramic symptoms at first slight (lack of appetite occasionally a little nausea) and later more progressive changes which may result in serious vomiting headaches dizziness inability to eat food or drink water properly. Marked foulness of the breath (uramic) is eventually noted along with cloudiness of vision frank uramia going on eventually to coma and death. If in addition to the back pressure effects pyelonephritis occurs on one or both sides the serious symptoms may increase rapidly and be characterized by chills fever and evidence of pyelonephritic kidneys, in addition to the rapidly increasing symptoms of uramia. One of the most important results of renal back pressure and loss of function is an increase in the blood-pressure which may suddenly mount resulting in very serious cardiovascular symptoms. In each case therefore, it is essential not only to discover the early symptoms of obstruction but also those of renal back pressure and impairment and cardiovascular changes. There are no patients who require more careful histories or clinical studies in order to determine not only the local condition but also the remote effects.

Hemorrhage may occur either slight in amount or pronounced, with marked hematuria or even the passage of clots. It may come from the dilation of the blood vessels in the posterior urethra and vesical neck or from marked hyperemia within the bladder. In some cases ulceration is the cause. Polyps may occur at the vesical orifice or in the urethra and sometimes papillary tumors. More frequently hemorrhage comes from instrumentation and this is one of the reasons for avoiding catheterization cystoscopy etc until the patient is prepared to enter a hospital immediately if necessary.

In conclusion it may be said that the symptoms of prostatic obstruction are (1) vesical in the difficulty and frequency of urination with hemorrhage and the development of calculi occasionally (2) renal the back-pressure effects upon the kidneys and (3) cardiac with changes in the cardio-vascular system. The ultimate results are the development of uramia profound infections and great bodily impairment.

EXAMINATION IN PROSTATIC OBSTRUCTION

This may be tabulated briefly as follows

- 1 General examination
- 2 Cardio-vascular pulmonary and abdominal examination
- 3 External genitalia
- 4 Rectal examination
- 5 Urethral catheterization
- 6 Cystoscopy
- 7 Kidney function
- 8 Blood chemistry
- 9 Roentgen-ray studies
- 10 Urinalysis

1 **General Examination** —In this the condition of the patient, his strength and vitality should be carefully looked into, *e g*, the cerebral, dental, naso-pharyngeal, neurological, ophthalmical and gastro-intestinal pathology should be sought for, particularly the development of a uremic breath, eye changes, the mental status, psychoses, neuroses, spinal changes, etc

2 **Cardio-vascular, Pulmonary and Abdominal Examination** —Cardio-vascular changes are among the most important complications, and the pathology which accompanies them should be carefully searched for, such as those associated with high blood-pressure, including cerebral, ocular and other changes. Changes which apply to the heart itself (myocarditis, angina pectoris, valvular lesions, dilatations, pericardial changes, aortic pathology, etc) should be carefully looked for. If the history of the case, and a cursory examination of the cardio-vascular system indicate distinct impairment, a competent internist should be consulted. It is usually very desirable that the urologist have associated with him one or more internists, who have become accustomed to pathological conditions found in the aged, accompanying or resulting from prostatic disease. The urologist is able to avoid many disasters by subjecting the patient to appropriate therapy until he has arrived at an optimum condition of the heart, blood-vessels, blood-pressure, etc. It is amazing what great improvement follows rest in bed, digitalization, continuous catheterization, internal hydrotherapy. During this period the consulting internist may be of tremendous assistance in regulating the course and determining when the patient is in an optimum condition for operation.

The pulmonary and abdominal examinations are routine, but thorough. An effort should be made to discover changes in the kidneys on palpation or percussion. Occasionally hydronephrosis may be made out, and if inflammatory changes have occurred, tenderness may be elicited.

3 **External Genitalia** —The routine examination of the penis, scrotal contents and perineum is carried out, being careful to discover pathological changes, particularly those of the epididymis, which may be the result of simple or tuberculous epididymitis. One should note abnormalities in the spermatic cord and its surroundings. Such sometimes are seen in filariasis. In addition, glands in the groin, *heiniæ* (sometimes resultant upon straining at urination, and in rare instances, containing a portion of the bladder wall) should be also noted.

4 **Rectal Examination** —We prefer to have the patient bend over, and place his elbows on his knees. With the gloved finger, a study is made of the anal region, hemorrhoids, fistulæ, etc, being noted. Any changes in the rectal lumen, or its mucosa or musculosa are noted, and any perirectal pathology. In cases of marked hypertrophy the rectal lumen may be greatly reduced. Where periprostatic inflammation has occurred, marked adhesions to the rectal wall may be present, and strictures of the rectum due to encircling inflammatory masses may have occurred. It is important to discover any such pathology,

as operations through the perineum may be seriously interfered with by inflammatory and fibrous conditions in and about the perineum and the ischio-rectal fossa. In the examination of the prostate per rectum

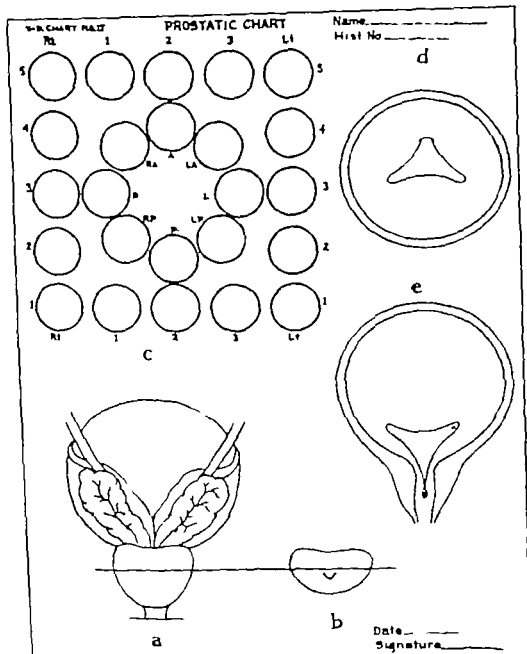


FIG. 360.—Young Diduch prostatic chart. *a* for recording deviations from normal prostate and seminal vesicles on rectal examination. *b* cross-section through verumontanum. *c* cystoscopic chart. *d* interpretation of cystoscopic findings at vesical neck. *e* interpretation of cystoscopic findings in floor of urethra and median portion of prostate.

the operator should preferably use the left forefinger and at the same time draw upon a schematic chart the outlines and cross-sections of changes in the prostate, membranous urethra, seminal vesicles, etc. (Fig. 360). Much experience is required to accurately delineate the

changes in the prostate as found by the palpating finger. It is amazing the great variation seen in charts prepared by experienced members of the same staff. One difficulty is to determine, with fair accuracy, the exact size of these structures. By comparing the dimensions with the breadth of the finger, or the length to which it has to be introduced, more accurate charts may be secured. By determining with the finger the distance between the outer edge of the prostate and the pelvic

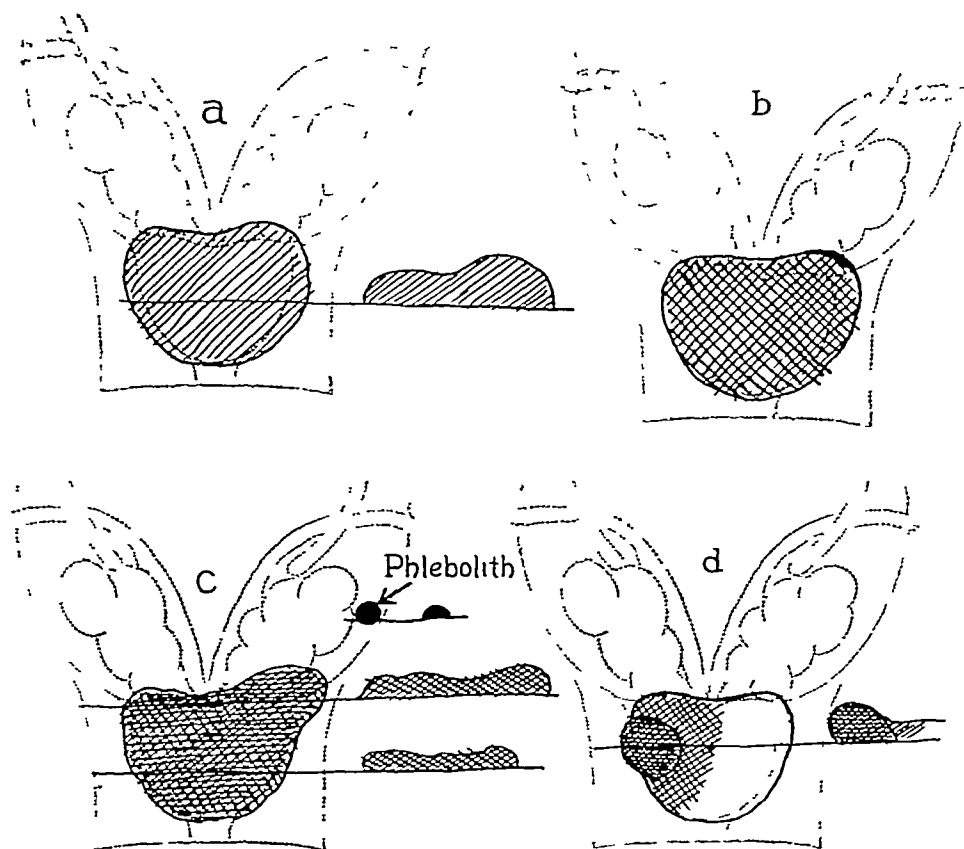


FIG. 361 — *a*, Slight enlargement of prostate with induration of first degree. Section shows right lobe is more prominent than left, *b*, moderately enlarged prostate in which induration is of second degree, *c*, carcinoma of prostate in which induration is of third degree, as shown by lines in three directions. Cross-section shows that posterior surface is not prominent, but is irregular, and that it projects upward into region of right vesicle. A phlebolith at outer side of upper portion of left vesicle is shown entirely black of fourth degree induration, *d*, carcinomatous nodule of third degree induration springing from outer portion of left lobe, which is of second degree induration. Right lobe slightly enlarged and not indurated. Cross-section shows prominence of nodule.

wall, the ischiopubic ramus, triangular ligament, the dimensions and outlines of the prostate may be more accurately recorded. One should next indicate the elevation of the posterior surface of the prostate and of the vesicles above the normal on cross-section. In this way the size of the prostate in three dimensions is shown. Irregularities of the surface are also carefully noted on the drawing. The consistence should also be determined with great care. When the prostate is of normal consistence, no shading is used. When there is a first degree indura-

tion parallel lines in the area which is slightly indurated are made (Fig 361-a) Second degree or moderate induration is indicated by lines at right angle (or cross-hatching in the terms of the engraver Fig 361-b) Third degree induration is shown by lines in three directions (Fig 361-c) This represents very marked induration such as is produced by an area of carcinoma. Calculi or tuberculous of the prostate may also resemble that of carcinoma (Fig. 362)

The areas of third degree induration should be most carefully delineated. One should endeavor to determine whether it is immediately

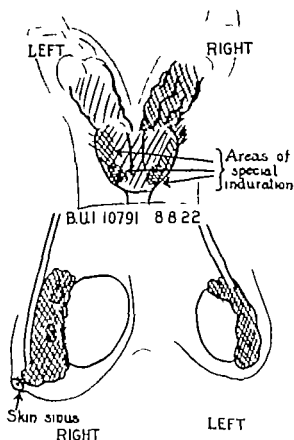


FIG 362—Rectal and scrotal findings in a case of bilateral genital tuberculosis. Note irregular nodular character of prostate. Swelling of left testicle began two years previously. Patient also had acute gonorrheal urethritis. Treatment—double epididymectomy.

beneath the capsule or covered by a layer of elastic prostatic tissue to discover whether the indurated area extends beyond the capsule of the prostate along the membranous urethra backward towards the rectum or upward into the region of the seminal vesicles. The presence of third degree induration varying in size from that of a pin head to that of a pea bean or small nut, must be carefully studied, marked on the chart with lines in three directions to receive further consideration when additional diagnostic methods have been carried out. Stones within the prostate near the capsule are usually indicated with fourth

degree induration, completely black (Fig 363) Similar stones within the veins (phleboliths) are similarly indicated Later roentgen-ray confirmation is sought to determine whether these indurated areas are really calculi or not The condition of the tissues around the pros-

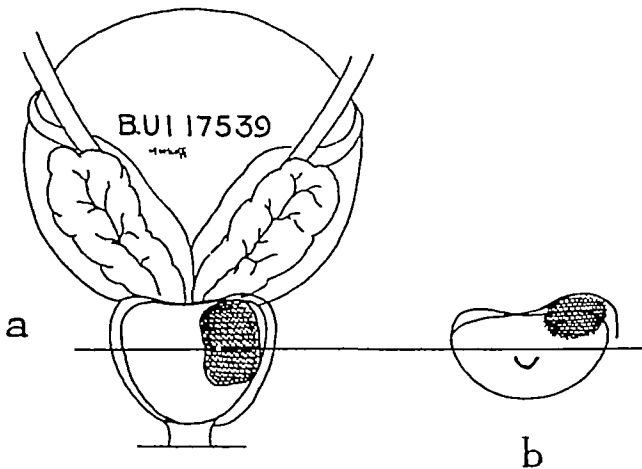


FIG 363 —Rectal chart showing large area of calculi in right lobe of prostate in patient, aged forty-six years, with history of gonorrhea twenty-one years previously, and nocturia every two hours Calculi not detected by cytoscope Removal of calculi by perineal prostatectomy Removal of small bar, but not lateral lobes Cure B U I 17539

tate, changes, such as inflammatory adhesions, or invasion into the periprostatic tissues, are appropriately indicated The condition of the seminal vesicles and vasa deferentia is most important, as it may indicate infection (Fig 364), or in malignant cases, an upward exten-

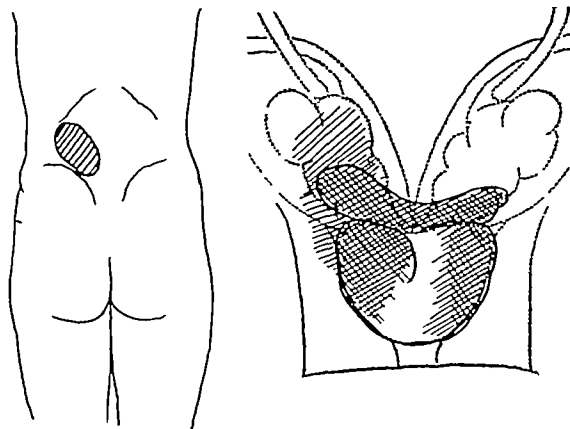


FIG 364 —Chart showing findings on rectal examination, and painful area in left lumbar region in case of chronic prostatitis and seminal vesiculitis

sion of the growth (Fig 365) Here again the outline, cross-section of the degree of induration, and the presence of adhesions is carefully marked on the chart Proper charting of the recto-prostatic region is of the greatest importance Students and house-officers should be

carefully instructed and checked in this work. The aphorism of Oler is still true, viz. that the difference between a good doctor and a poor one is that the good doctor knows how to make a proper rectal examination and has enough *tactus eruditus* to recognize what he feels. If physicians could be made to realize the importance of rectal examinations and particularly of noting upon a chart the variations in induration described above, far more accurate ideas of the prostate and its adnexa would be obtained and many cases of early cancer of the prostate suspected and brought to early operation.

The normal prostate is of elastic consistence. With the onset of inflammation this may be greatly changed. In the small fibrous prostate, generally associated with contracture of the vesical neck, median bars and small lobes, the consistence may be generally hard as in marked chronic prostatitis. There may be some enlargement generally associated with adhesions on one or both sides. In such cases the seminal vesicles are apt to be definitely firmer, more adherent and

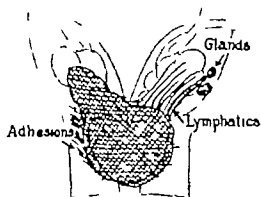


FIG. 365. Case of carcinoma of prostate involving left seminal vesicle and glands along right lateral wall of pelvis.

sometimes larger than normal. Changes in the ampulla are more difficult to make out. In simple benign hypertrophy unassociated with inflammation the gland is fairly smooth in outline, more or less globular, projecting posteriorly as shown in the cross-section. The consistence is generally elastic and only a little firmer than the normal prostate. In some cases, however, the spheroids and their encapsulated tissues are distinctly firmer than normal, being charted as second degree. In rare instances the induration may be considerably harder, almost of third degree. A small lobule may break through the posterior lobe and appear beneath the capsule with induration so pronounced that carcinoma may be suspected (Fig. 366). In such cases the nodule should be labeled suspicious and perineal exposure advised so that the operator may see, feel and if necessary incise the nodule to determine whether or not it is cancerous. The size of the prostate on rectal examination may vary from very slight to huge enlargement. In the very great prostates one must consider the possibility of sarcoma, especially if they are very soft, although some may be hard.

It is important to get the upward extent of the growth, and in order to do this, it is sometimes wise to turn the hand so that the back of the finger rests against the anterior wall of the rectum and the prostate beneath it. In this position the posterior part of the sphincter ani and the coccyx above, pass between the first and second fingers, so that the finger within the rectum can be pushed inward at least 2 to 3 cm farther. Palpating with the back of the finger, and even with the nail, it is possible to get an accurate idea as to the extent of the growth, the configuration, the consistence, adhesions, involvement of other structures, etc., so that the huge masses can be encompassed and carefully charted.

In conclusion we wish to stress the importance of the rectal examination, and the necessity of so improving the *tactus eruditus* that accurate estimations of the size, contour, consistence, degrees of induration, etc., may be accurately recognized, charted and faithfully considered in the diagnosis.

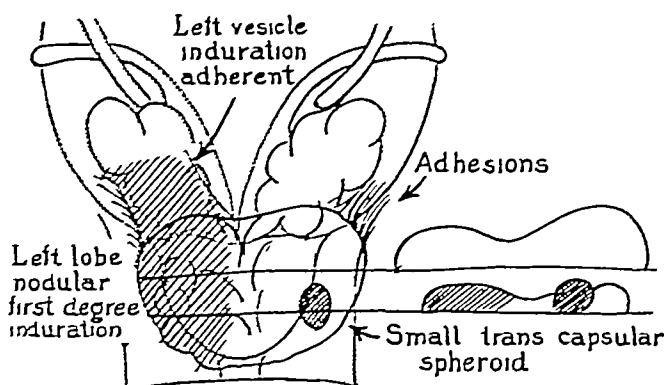


FIG 366 —Prostatic chart in a case of considerable hypertrophy of right lateral and lesser hypertrophy of left lateral lobe. Spheroid, which has broken through the posterior capsule shown, also on section. Nodular first degree induration of left lateral lobes indicated, as is also induration of left seminal vesicle and adhesions.

5 Urethral Catheterization —This may be fraught with very great danger. Whether to use a catheter or not must therefore be seriously considered. In cases of prostatic hypertrophy the posterior urethra is often very abnormal, the enlarged lobes causing great alterations, marked compression here and there, great widening of the urethra, with the formation of pockets, much elevation of the middle lobe, which must be surmounted. At times there is marked constriction of the urethra. Catheterization, even though expertly done, and carried out without difficulty, may be followed by edema, congestion, swelling and changes in the lumen, which lead to increasing difficulty of urination and often complete retention. Urethral catheterization is, therefore, not to be entered into lightly. The physician should be in a position to master promptly the complications which may occur. Catheterization should be done with the greatest care. Asepsis here is almost more important than in an abdominal operation, as the peri-

tomeum may take care of the bacteria readily whereas the posterior urethra and bladder form a fertile field for their growth.

Elsewhere will be found complete details of the technique of catheterization but it is worth while to reiterate here that the instruments, the hands of the operator, the penis and the anterior urethra should be sterilized before an instrument is passed. A rubber catheter of medium size say No. 16 or 18-F is usually the instrument of choice. A rubber catheter with a coude beak can often be introduced more easily than a straight catheter. A gum coude or bi-coude catheter will often pass over great median enlargements which completely obstruct other instruments. A rubber catheter should not be of the so-called velvet-eye type but should contain a pocket in the extremity into which the end of a stylet may be passed. These metal stylets can be given any desired curve so that the catheter can be made to rise above the enlargements or obstructions. A styleted catheter however must be used with the care of metal catheters as it is possible to produce traumatism and even false passages by their too vigorous use. Patients to be catheterized should be ordinarily afforded hospitalization or as stated before be under the continuous care of a physician well equipped for such work.

When complete retention of urine suddenly occurs every effort should be made to assist the patient to void naturally before attempting catheterization. A hypodermic injection of morphine ($\frac{1}{2}$ gr.) will often result in relaxation of the spasm and facilitate urination. A hot sitz bath or a large enema may also be of assistance. Injections of warm milky antiseptic solutions into the anterior urethra with a rubber bulb or fountain syringe will sometimes stimulate urination. The passage of a small sterile filiform may likewise be effective.

These simple methods having failed catheterization is then indicated. The physician should be prepared with a variety of appropriate instruments in order that he may enter the bladder without traumatism and infection. In cases in which the pliable instruments—rubber and gum straight and coude—cannot be passed even if provided with a stylet a metal catheter may be required. One with the standard curve may enter but not infrequently a prostatic catheter with a large curve similar to that of Guyon may be required. If however great difficulty is experienced before traumatizing the urethra too greatly by the passage of successive instruments the use of a filiform attached to a gum catheter or bougie may lead to easy entrance and evacuation of the bladder. If catheterization is very difficult and finally accomplished only after many attempts and with more and more traumatism of the posterior urethra the patient must be considered in jeopardy and preferably sent into a hospital.

If all efforts at catheterization fail and the bladder is greatly distended *suprapubic puncture and aspiration* of urine must be considered. Before attempting this the operator should be certain that the bladder is palpable well above the symphysis pubis so that the peritoneum which usually extends nearly to the symphysis is surely pushed

upward sufficiently far so that a needle, introduced immediately above the symphysis, will enter the bladder without injury of the peritoneum. A needle, not too large, but sufficient to aspirate the bladder contents, 8 to 10 cm in length, should be employed. A sufficiently large glass syringe to facilitate the evacuation is desirable. As the bladder empties, care should be taken to see that the end of the needle does not injure the deeper portion of the bladder and prostate. As the needle is withdrawn, a mild antiseptic, such as 2 per cent mercurochrome, in very small amount, may be injected to prevent infection of the pre-vesical wound. After aspiration the patient is often able to urinate naturally.

Unless the patient is in complete retention, catheterization may generally be left to be done at cystoscopy, when the interior of the bladder and prostate are to be studied, as will be described later on.

Vesical Decompression It is important to point out here that when the bladder is overdistended, it never should be evacuated completely with a catheter. Experience has shown that grave complications may set in when a bladder, which has become overdistended, is completely emptied. "Progressive decompression," as I have named it, should be carried out. The reasons for this are as follows. As mentioned before, a progressively increasing residual urine is accompanied by gradual dilatation of the ureters, kidney pelves and calyces, thinning of the renal cortex, impairment of renal function, accumulation of nitrogenous products in the blood, and often gradual increase in hypertension. Complete evacuation of a bladder, thus distended, results in an onrush of blood into the kidneys and lower urinary passages, leading sometimes to petechial hemorrhages in the mucosa. These may appear throughout the urinary tract. At the same time the marked change in the blood-pressure may lead to immediate change in renal function. A considerable drop in the blood-pressure often occurs when the bladder is completely emptied with a catheter. This also contributes to lessening of urinary secretion, and even suppression. It is, therefore, imperative that the physician should very carefully percuss the bladder to determine whether there is present a large amount of residual urine after catheterization. If this viscus is percussible a finger's breadth or so above the symphysis, a residual urine of 300 to 400 cc may be expected. If the dullness reaches the umbilicus, 1000 cc residual urine is usually present. In both instances a soft rubber catheter should be passed, if possible, and the vesical tension or pressure should be determined. This may be very accurately obtained by the use of our decompression apparatus (Fig 367), which provides a tube at the base of the instrument to connect with a movable device by which the point at which the urine ceases to flow is registered upon a centimeter scale. This furnishes the tension or bladder pressure under which the urinary system has been laboring. Then, having determined the bladder pressure, the outlet is lowered 2 to 3 cm so that partial evacuation may be begun. It is continued at this level—only slightly lower than the tension upon which the bladder has been laboring. By this means

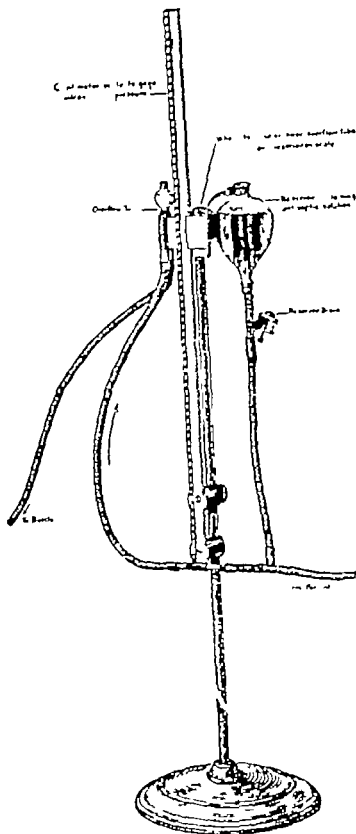


FIG. 4. —Decompressing manometer used in gradual reduction of high residual urine (Young-Shaw)

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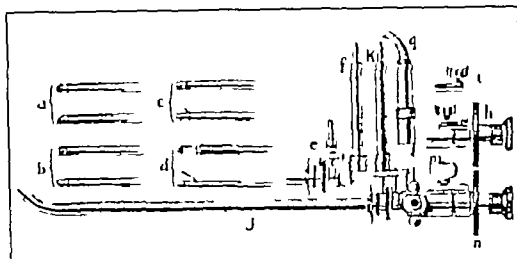


FIG. 368.—Young's improved composite irrigating cystoscope.—anterior sheath, *J*. *a*, *b*, lamp and fenestra on concave side of instrument *J*. Note following innovations: *L*, large irrigating cocks, which rotate around shaft of instrument and connect with long connecting handle *K*, which connects with electric cord *C*. *A* shows large disk for rotating instrument thus removing fingers from eye-piece. In *H* is shown new type of fixation device for holding telescope to outer sheath. *I* shows other side of same mechanism. In *M* old style connecting mechanism is shown. *F* and *F'* represent alternative method in which long connecting handle is replaced by ordinary connecting piece *E* with long intervening removable handle *F*. This will be found to facilitate packing of instrument. The following lens systems may be had with instrument: *B*, plain observation right-angle telescope; front and side views; *I*, forward view (antegrade) telescope; *C*, retrograde view telescope; *D*, catheterizing telescope; right angle lenses. The instrument may also be had with the old "screw lamp" back.

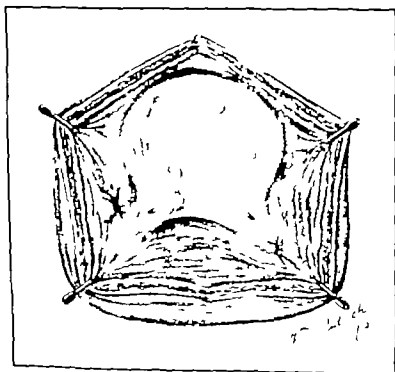


FIG. 369.—Autopsy specimen showing median portion of prostate with marked hypertrophy of trigone.

sudden pressure changes in the bladder, ureters, pelvis and kidneys are avoided, hemorrhage is prevented, a rapid drop in blood-pressure avoided, and suppression of urine prevented. The outlet may be lowered 2 cm every two hours. If hemorrhage should occur, the height should be slightly increased until the hemorrhage ceases. As a rule, within twenty-four or forty-eight hours, even in cases in which 1000 cc residual urine has been present, the outlet may be brought to zero, the apparatus removed and free catheter drainage allowed. The avoidance of infection continues to be of great importance. Most careful technique in connecting drainage tubes to the catheter must be employed. Lavage of the bladder with mild antiseptics is carried out by placing 2 per cent boric acid or 1 to 6000 potassium permanganate in the glass receptacle attached to the stand. On removal of the decompression apparatus the catheter should be carefully fastened in place with some of the various types of rubber apparatus to be found on the market, or by means of narrow strips of adhesive plaster. A small amount of stronger antiseptics, such as 5 per cent argyrol or 1 per cent mercurochrome should be injected into the bladder. The catheter should be changed sufficiently often to avoid marked urethritis. The urethra, both pendulous and perineal, should be carefully palpated twice daily to discover if any periurethral infection is present. The development of even a small periurethral abscess may lead to fatal septicemia. Its discovery should be followed by immediate evacuation and the insertion of a drainage tube, either suprapubically or through a bulbar urethrotomy. The use of antiseptics also prevents the encrustation of the catheter with urinary salts. No catheter should be allowed to remain in the urethra or bladder long enough to develop such encrustations, which are a fertile source of vesical calculus formation. With great cleanliness and antiseptic care, a catheter may often remain a week without being changed, but with the development of irritation and other complications, renewal every two to three days may be highly desirable. The duration of catheter drainage depends very largely upon improvement in renal function, which will be taken up later. As stated above the first catheterization is often done with the evacuating cystoscope.

6 Cystoscopy — *Choice of Instruments* — Our preference is for a combination cystoscope (Fig 368) which is provided with two sheaths, anterior and posterior. The latter is of special use in that it may be drawn into the posterior urethra, and excellent views of the intra-urethral lobules, etc., obtained. It is advantageous to have three telescopes, right angle, antegrade and retrograde. The same instrument is provided with a ureter catheterization telescope, which may also be used for fulguration of bleeding points, tumors, etc.

In the cystoscopic study of prostatic hypertrophy the posterior sheath is usually preferable. It is introduced with an obturator. The residual urine and bladder capacity are carefully noted, cultures obtained, and the bladder washed clean. It is usually desirable to study the bladder first, making careful notations on the condition of

lateral lobes (Figs. 371 and 372) The lateral lobes are successively recorded in R \ R RP LA I and IP These margins which are normally slightly concave become more and more convex according to the degree of lateral enlargement P records the median lobe Normally this margin is only slightly curved but with the development

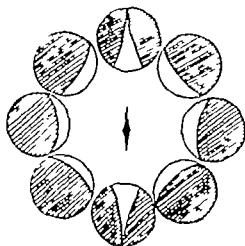


FIG. 371.—Bilateral hypertrophy clefts anteriorly and posteriorly corrected view lens system.

of a bar or a lobe this increases and after introduction the cystoscope is raised more and more above the level of the trigone until the latter may be completely obscured PR + PI (Fig. 373) In this process clefts may appear on one or both sides of the median enlargement The median lobe may be continuous with one of the lateral lobes (Fig. 374) It may rise up so greatly that the cystoscope naturally falls into a sulcus on one side of it (cystoscopy carried out with the

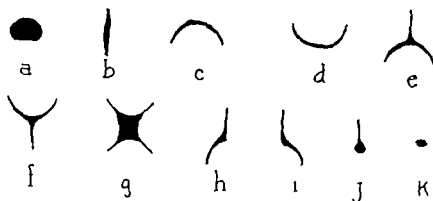


FIG. 372.—Normal orifice (a) and changes made in it by lobes arising from different quadrants of prostate

instrument in this position will often reveal a confusing picture in which one sees a greatly enlarged lateral lobe which is in fact, a large median rising up above the cystoscope on one side and obstructing the view of the lateral lobe (Fig. 375) If the median lobe is not too large it is usually possible by manipulation to carry the shaft of the

the trigone and the bladder musculature. Hypertrophy of the trigone, as we first pointed out, indicates obstruction in the median portion of the prostate which must be pulled down before the vesical orifice is opened and micturition initiated by the bladder (Fig 369). Trabeculation indicates overwork of the bladder muscle to evacuate the urine through the narrowed orifice or prostatic urethra. These diagnostic lesions, or their absence, having been noted, attention is next directed to the prostatovesical orifice. In order to record accurately the condi-

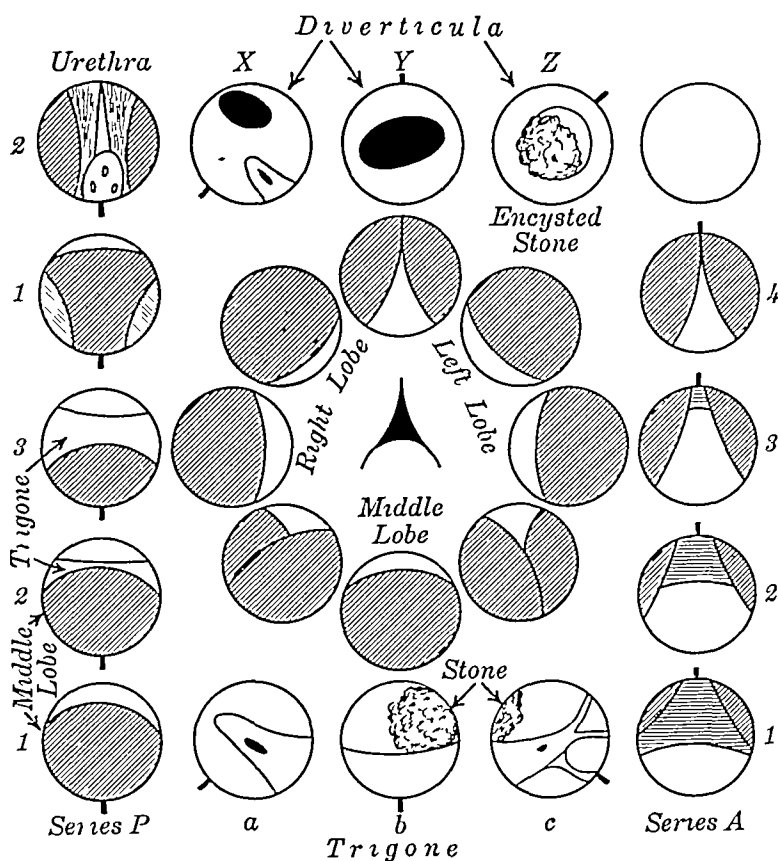


FIG 370 — Case of bilateral and median hypertrophy of prostate with hypertrophied trigone, trabeculated bladder (c) diverticula (XY), and encysted calculus (Z). Series A shows anterior margin in 1. As handle of cystoscope is elevated, lateral lobes come closer together and anterior margin disappears in 4. Series P shows appearance of trigone as handle is gradually elevated (a and 3). Urethra shown by drawing out cystoscope verumontanum, ducts and hypertrophied lateral lobes visible (2). Stone free in bladder (b, c).

tions present a chart (Fig 370) should be employed. This contains a series of eight circles upon which the views obtained by looking anteriorly, to the right, posteriorly, to the left, and also intervening directions may be carefully recorded. As has been indicated before, the right angle cystoscope is, in fact, a periscope. It requires a series of about eight views to inspect the entire horizon of 360 degrees. In the normal prostate the anterior circle records a slightly concave transverse line. With the development of an anterior lobe this becomes convex. With bilateral hypertrophy it becomes a "V"—a mere slit between the

lobe and descend into the opposite sulcus. If this is possible a series of cystoscopic pictures is obtained quite the opposite of those obtained with the shaft of the instrument in its previous position *i. e.*, in the sulcus on the other side of the middle lobe (Fig. 376). In this way an accurate record is obtained of the changes in configuration of the vesical orifice, the increase of the individual prostatic lobes and their effects upon each other are readily understood. The mechanics of the obstruction are thus accurately delineated, and the operator thus forewarned as to the condition present can plan the necessary steps to meet them at operation. Having thus very carefully studied the situation at the vesical neck and noted the contours, the condition of the mucosa, the presence or absence of edema, polyps, hemorrhagic points, etc., are observed and noted on the chart. (Active hemorrhage may be arrested by fulguration on introducing the catheterizing telescope.) The posterior sheath which is being employed may then be withdrawn into the prostatic urethra and as it passes out the anterior surface of the median portion, the encroachment of the lateral lobes upon its anterior surface and further down the urethra, the relationship of the lateral enlargements to the verumontanum may be studied, the presence of dilated gland ducts, pouches, diverticula, calculi, polyps may be seen. In the study of the posterior urethra the antegrade telescope is of great value and often gives more accurate pictures than the right angle telescope. The retrograde telescope is used with the anterior sheath in order that proper illumination of the vesical orifice may be obtained. This telescope is of assistance in studying the configuration of the intravesical projections of the lateral and median lobes.

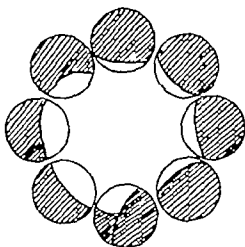


FIG. 376.—Prostatic orifice in large median lobe hypertrophy, cystoscope in sulcus to left of lobe.

In some instances the cystoscope is difficult or impossible to introduce, and a beak provided with a detachable filiform may be necessary. Cystoscopy should be done rapidly so as not to overtax the patient. This is particularly important in the very aged and in some of these especially where marked cardio-vascular and renal complications have been present, it may be advisable to dispense with cystoscopy altogether. In such cases simple roentgen-ray examination and cystography should be done in order that the presence of calculi or diverticula may not be overlooked.

7. Kidney Function.—This is one of the most important examinations to be made in cases of prostatic obstruction. As stated above, changes in the renal function as a result of prostatic obstruction, or vesical back pressure are very insidious and blood chemistry cannot be relied

cystoscope into the sulcus on the opposite side of the middle lobe. This is easily done by greatly depressing the handle of the cystoscope and carrying the instrument gradually to the opposite side externally, thus forcing the shaft to mount the summit of the enlarged median

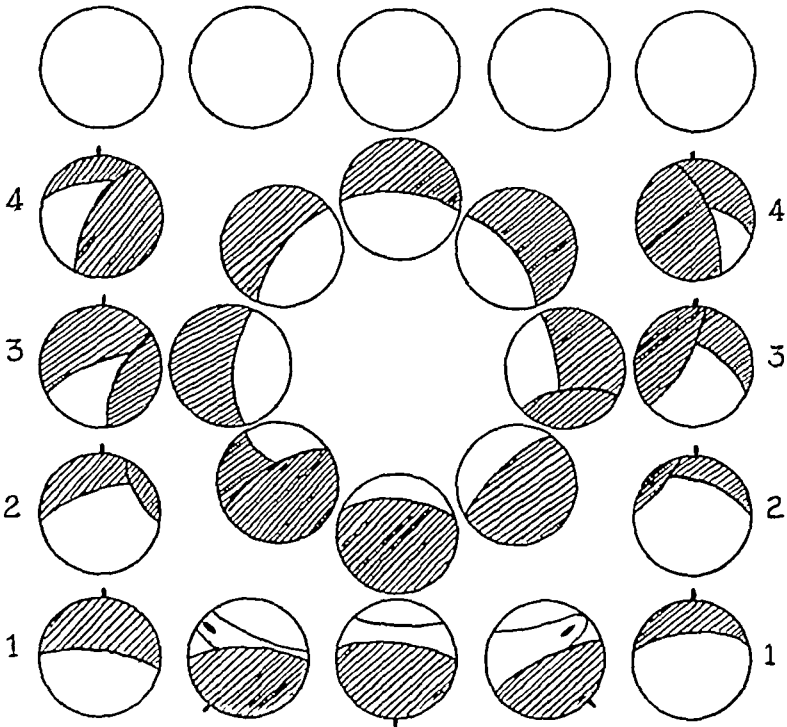


FIG 373 —Cystoscopic picture in case of fairly large median lobe hypertrophy without lateral or anterior lobes. Trigone largely obscured. By carrying handle of instrument forcibly to either side shaft of instrument drops into sulcus on opposite side of middle lobe. When handle is depressed in that portion (No 1) anterior margin alone is seen. As it is gradually elevated (2 and 3) it passes on one side of median lobe which finally obscures portion of anterior margin (4).

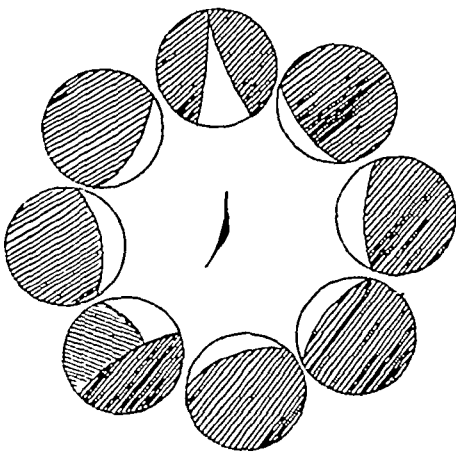


FIG 374

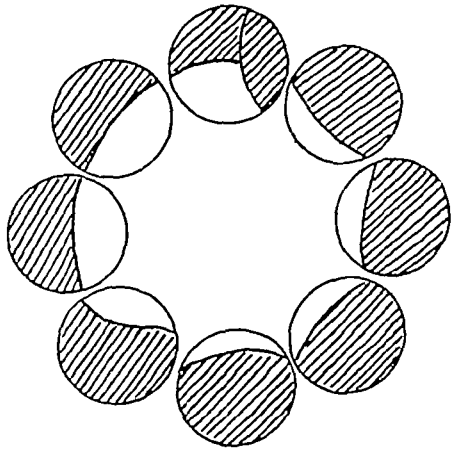


FIG 375

FIG 374 —Cystoscopic chart in case in which hypertrophied median and left lateral lobes are confluent. Right lobe hypertrophied, clefts in anterior view (A) and right-posterior view (RP).

FIG 375 —Prostatic orifice in large median lobe hypertrophy, cystoscope in sulcus to right of lobe.

ance was thus obtained in the study of urological cases and the determination of when the renal function had improved sufficiently for operation to be undertaken.

With the passage of time we encountered many cases in which the two-hour total was about equal but the elimination much faster and the amount excreted in the first half hour much greater in some cases than in others. We then undertook studies to determine how rapidly the drug was eliminated. Shaw¹ demonstrated in a great series of cases that a high percentage of the drug was eliminated within fifteen minutes and after that the curve was a rapidly descending one. To put these facts into operation I devised a phthalein chart (Fig. 377) in which the appearance time and the elimination at half hours was to

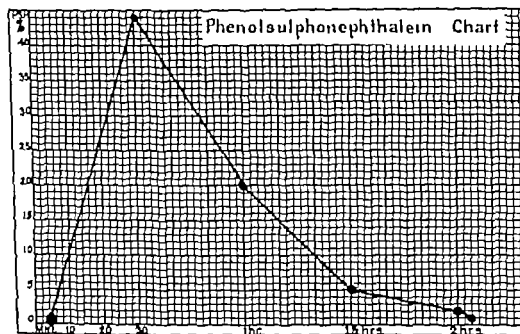


FIG. 377.—Normal curve of phthalein excretion (Young chart). This shows the appearance time shown in minutes below the excretion % each half hour.

be charted. As shown here the amount eliminated in elderly men without prostatic obstruction is about 40 to 50 per cent in the first half-hour, the appearance time being generally between three and five minutes. The amount eliminated at successive half hours rapidly decreases.

This phthalein chart has now been used in hundreds of cases and has proved invaluable in demonstrating the renal function on admission of the patient, and the progressive improvement resulting from catheter drainage. As will be seen in Fig. 378 in a case of chronic obstruction the appearance time was eight minutes and the amount excreted in the first half-hour only 10 per cent. The excretion during the second half-hour was 20 per cent, the third 15 per cent, the fourth 10 per cent.

¹ Jour. Urol., 13: 575, 1925.

upon to discover early changes After having tried all methods, which have been proposed for renal function determination, we are convinced that the phenolsulphonphthalein test is the best This drug, discovered and reported by Remsen¹ was put aside by him as merely interesting chemically Fifteen years later Abel showed that almost all of the drug was eliminated through the kidneys He also put it aside, and ten years later Rowntree showed in laboratory animals, in which the renal artery on one side had been injected with ammonium nitrate, that more of the drug was excreted from that kidney, in which he thought a chemical nephritis had been produced At our suggestion the drug was then tried on urological patients It was shown that the drug was eliminated in lesser quantity, not by the normal kidney, but by the abnormal kidney The extensive studies made by Geraghty and Rowntree² in patients on the urological service, proved that the drug was of the greatest value in determining the actual functional capacity of the kidneys, and the progressive impairment of function which gradually occurred from prostatic obstruction They recommended that the urine be collected for two periods of one hour each after the appearance of the drug With the use of this test³ tremendous assist-

¹ American Chemical Journal, 6, 280, 1904 ² Arch Int Med, 9, 284, 1912

³ *The Phenolsulphonphthalein Renal Test Materials Required* (1) An ampule of phenolsulphonphthalein (H W D) containing little more than 1 cc of sterile physiologically standardized solution suitable for intravenous injection, (2) an accurate 1-cc glass syringe with suitable needle, (3) 6 receptacles for urine, into the first of which about 5 grains of anhydrous sodium carbonate has been placed to bring out the pink color, showing the appearance of phenolsulphonphthalein (sodium hydroxide may produce severe burns), (4) a proper apparatus for accurately estimating the output of phthalein excreted in a given period The Young-Elvers phthaleinometer or the Dunning-Hellige apparatus are to be recommended

Technique The patient drinks 500 cc of water Thirty minutes later he drinks 250 cc water, and voids An injection of exactly 1 cc phthalein is then made, preferably intravenously, and the exact time noted Five minutes later the patient is requested to void in Glass No 1 A definite pink color should appear in normal cases If not, the patient is requested to void thereafter every five minutes into a jar containing sodium carbonate until the color appears This is noted as the appearance time after injection The patient is next asked to void exactly thirty minutes after the injection of the drug, and thereafter every thirty minutes until 4 half-hour specimens are obtained He also drinks 250 cc water each half hour

If the two-hour elimination after appearance is desired, the patient is asked to void after the last half-hour period at exactly the number of minutes shown in the appearance time This gives two charts, one for two hours after injection, and another two hours after appearance—the total two-hour elimination

After intramuscular injections, the appearance is often delayed to ten minutes, and the half-hourly excretion reduced 20 per cent

Each specimen of urine collected should be measured, diluted up to 200 cc, and further alkalinized by the addition of 2 to 5 cc of 5 per cent sodium hydroxide A specimen should be further diluted up to 1000 cc, unless it is very pale, when dilutions to 500, 300 or only 100 cc may be used in order to obtain satisfactory readings

To compare the specimen with the colored glass standard in the colorimeter, fill the tube behind the standard scale with urine obtained before the test is begun, diluted to 1000 cc (or the fraction thereof employed) Fill the comparison tube with alkalinized diluted urine containing the output of phthalein Move the sliding scale up and down the standard until the colors correspond The figure on the central bar opposite represents the percentage of phthalein present If dilutions of less than 1000 are used, the result may be obtained by using the formula

$$\frac{\text{Amount of diluted specimen}}{1000} = \frac{X}{\text{colorimetric reading}}$$

Readings should be made as soon as possible after collection Alkalinized phthalein decomposes rapidly, so that excessive addition of alkali should be avoided

of cultures blood studies etc. This chart furnishes a fairly complete record of the laboratory studies made on urological cases and has now been employed with great success in several thousand cases.

8. **Blood Chemistry** — *The Blood* — Estimation of the hemoglobin red and white blood cells is of course routine. When interesting

CHART NO. _____ LABORATORY CHART _____ DATE NO. _____

Phenolsulphonphthalein Chart

Time	Temp	Pulse	BP	Respirations	Sp. O ₂	Sp. CO ₂	Sp. H ₂ O	Sp. N ₂	Sp. O ₂	Sp. CO ₂	Sp. H ₂ O	Sp. N ₂
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Blood Chemistry

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the two-hour total being 51 per cent As a result of continuous catheter drainage, the steady improvement in renal function is well shown in the successive elimination curves

Having arrived at a fairly normal curve, the patient being otherwise fit, he was subjected to operation successfully

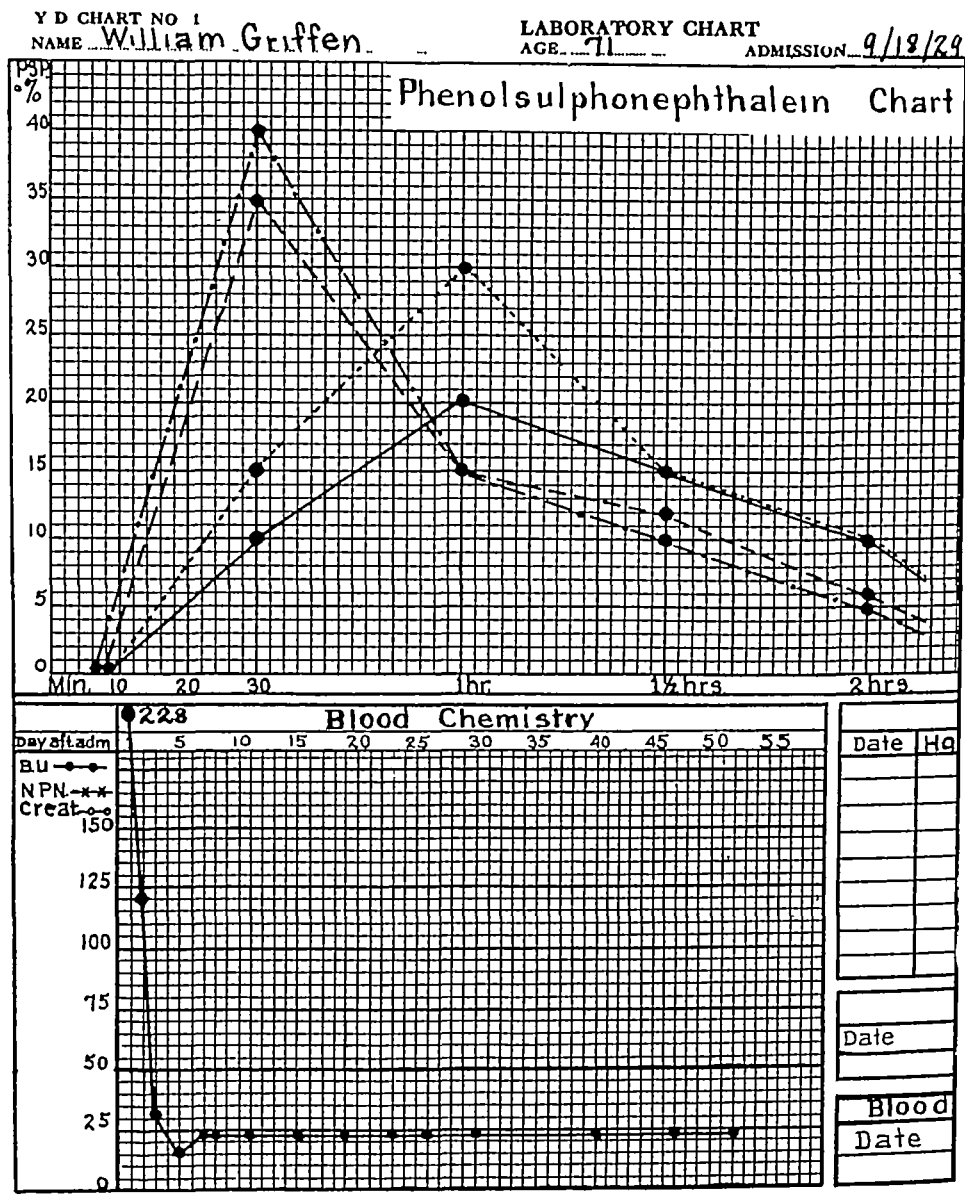


FIG 378

The chart was further elaborated in order to show the blood chemistry, and also other valuable notations (Fig 379) On this are recorded the exact figures of the phenolsulphonphthalein test, as well as the blood urea, (or, if one wishes, non-protein nitrogen or creatinine), the urinalyses, blood-pressure, residual urine and bladder capacity, reports

there was a progressive improvement in renal function as shown by the gradually rising phthalein excretion and the rapid fall in the blood urea. In the literature one finds it frequently asserted that the determination of the blood urea is sufficient to inform one if the kidney function is reduced and that catheter drainage should be provided before operation. In a careful study, however, of hundreds of cases we have shown that the phthalein test is far more accurate than the blood urea which first demonstrates renal impairment at a much later date than the phthalein test.



FIG. 381.—Incorrect method of taking roentgen-ray in case of prostatic calculi. Calculi partially obscured behind symphysis pubis.

9 Roentgen-ray—This is so important that one should be taken in almost every case. A plain roentgen-ray film of the prostate will often reveal shadows which are due to calculi. It is thus of great value in differentiating between stone and carcinoma if an indurated area of great degree is found within the prostate. In order to obtain good pictures of the prostate the exposure should be made with the legs depressed, the back arched and the tube so placed that its rays will go directly down the pelvic girdle or strait. Unless this is done the shadow of the prostate usually appears immediately behind the symphysis pubis (Fig. 381). In such a position not only is the picture of the prostate obscured by that of the bones but changes from the normal are often attributed to the prostate when really in the bones. If properly taken prostatic calculi are shown by the roentgen-ray in the pelvic strait (Fig. 382). Of equal importance is a study of the pelvic

chill and fever following simple catheterization, or other instrumentation. If bacteriemia is present, cultures should be repeated each day, in order that a determination may be made as to when to begin appropriate treatment to combat the septicemia.

An estimation of the blood urea is a routine procedure in the Brady Urological Institute, Baltimore, Md. In other clinics, non-protein nitrogen, urea nitrogen, as well as creatinine, and other estimations, are obtained. In our experience the blood urea is the simplest and most satisfactory method to use in conjunction with the phthalein test in determining the condition of the kidneys. Twenty millograms per 100 cc blood is a low normal, 40 mg a fairly high normal, but when

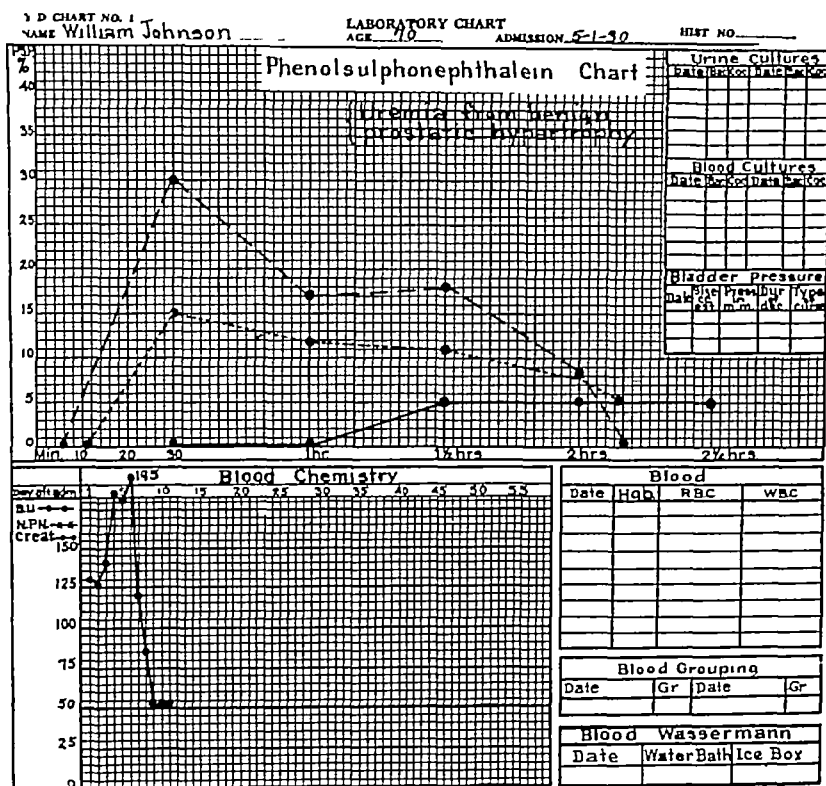


Fig 380

the blood urea is between these figures, no great significance is attached to it. When above 40 mg one must suspect the retention of nitrogenous products in the blood and renal impairment. In such cases one invariably obtains an estimation of the impairment also by means of the phthalein test, which as remarked before, shows a delay in the appearance time and a reduction in the excretion before the blood test indicates any increase. One of the most interesting clinical and laboratory studies is obtained by charting the successive daily blood urea estimations (Fig 380). As seen in this case, the patient on admission had a very high blood urea (126), and a poor phthalein appearance time (30 min) and only 10% excretion in 2 hours. Under catheter drainage

If cystoscopy is not satisfactory cystograms with 12 or 15 per cent sodium iodide solution in the bladder are often of great value. By means of the cystogram one is able to note changes in the vesical neck, lobes projecting into the bladder or a funnel-shaped dilatation of the prostatic orifice as seen with cord bladders and in children with congenital valves springing from the verumontanum. Trabeculation enlargement of the trigone diverticula ureteral regurgitation are among the important conditions revealed by the roentgen-ray. Shadowgraphic pictures of the urinary tract by means of intravenous injections of various solutions also furnish data of very great interest. In cases in which it is impossible or inadvisable to pass a catheter to obtain the residual urine it may be obtained with fair accuracy by intravenous



FIG. 384.—Roentgen-ray showing two large calculi in bladder with a calculus in diverticulum of left lateral wall.

urography. In one of our cases after the patient had voided as completely as possible an intravenous injection of neulopax showed an immense bladder 10 inches in diameter. This bladder occupied practically the whole abdomen reaching from the symphysis to the costal borders.

10 Urinalysis.—Before obtaining a specimen for urinalysis it is wise to cleanse the glans penis and the anterior urethra and obtain urine for cultures. This should be done before instrumentation of any sort is carried out. The cultures should be plated directly from the urine using the standard loop and counting the number of colonies which appear in the plate at the end of twenty-four and forty-eight hours. The remainder of the urine voided should be obtained in two or

bones and spine afforded in good roentgen-ray films. By such means metastases are recognized (Fig 383), and much assistance in diagnosis



FIG 382 —Proper method of taking roentgen-ray in case of prostatic calculi, which appear well above pelvic girdle and well above symphysis pubis



FIG 383 —Roentgen-ray showing typical metastases in case of carcinoma of prostate

between benign and malignant disease of the prostate obtained. The presence of calculi in the bladder within cellules or diverticula (Fig 384), or in the ureters, pelves, calyces, etc are promptly recognized

as pointed out before, varies greatly. At times only a rounded median lobe is present to produce obstruction. Generally it is combined with lateral enlargement. These, although small, may produce great obstruction and even complete retention, whereas much greater enlargement may not completely block the urethra, leaving interspaces through which the bladder is able to force the urine without much difficulty.

Congenital conditions are sometimes found which may have been present since birth, often with symptoms progressively increasing until great difficulty and complete retention occurs. Cystoscopy is of great value in showing the relation of the median portion to the trigone. Frequently bars or valves are found. In some cases with marked enlargement on rectal examination the orifice is uniformly concave with no evidence of involvement, simply a circular contracture. The presence of trigonal hypertrophy and trabeculation make the diagnosis of obstruction evident.

A third class is one in which there is a generalized fibrosis of the prostate without much enlargement. In these cases there is not only a contracture at the vesical orifice, but obstruction due to wide stricture of the posterior urethra. As stated elsewhere, these are usually inflammatory in type, but may not be associated with the presence of bacteria on admission.

Chronic Prostatitis—Chronic prostatitis is one of the conditions which must frequently be differentiated from prostatic obstruction. Although these cases may go on to obstruction, they are generally characterized by pus in the prostatic secretion, less frequently bacterial infection, chronic inflammation of the posterior urethra, verumontanitis in varying degrees, strictures of the ejaculatory ducts with consequent disorders of the seminal vesicles and sexual life, etc. The diagnosis is made on rectal examination, carefully charting the size, shape and induration of the prostate, by cystoscopy, with charting of the contour of the prostatic orifice and its relation to the trigone, presence or absence of hypertrophy of the trigone, trabeculation, cellulæ, bladder diverticula, etc. With the finger in the rectum and the cystoscope in the urethra, the difference between chronic prostatitis and definite enlargement of the median and lateral portions of the prostate can best be determined. Urethroscopy often furnishes the explanation of the irritability, dysuria, frequency and hematuria, and other symptoms which may simulate prostatic obstruction. With the cystoscope one may discover lesions within the bladder which produce symptoms resembling those of prostatic obstruction. Submucous or interstitial cystitis appears as an elevated, red area, sharply demarcated from the surrounding pale mucosa. In its center one often sees an adherent exudate or mucus, and on further distention of the bladder its surface frequently cracks and bleeds. The condition is not infrequently associated with median bars or contractures at the vesical orifice. It may be the reason why removal of these obstructions does not lead to normal urination. Other conditions in the bladder, such

three clean glasses for urinalysis, which should be complete and include besides simple microscopic study a stained centrifugalized smear for bacteria. In some instances it may be advisable to exclude the tubercle bacillus. By means of the cleansing above described, the Smegma bacillus is eliminated and any acid-fast organisms which are found may at once be declared the bacilli of Koch. Material for cultures and inoculations may also be obtained by the same sterile technique. Special study of the crystals present may sometimes be desirable, especially if calculi or alcaptonuria are suspected.

The frequent determination of the specific gravity is often of great importance in determining whether the kidney is able to concentrate well. It must be taken in conjunction with the amount of fluid consumed, and the total urine voided. A fairly accurate value of the renal function may be obtained by multiplying the amount of urine passed with the last two figures of the specific gravity, $e.g.$, 3000 cc times 16 (S.G. being 1016).

We have previously referred to the phthalein test. Unless the patient is able to empty the bladder completely, catheterization is usually desirable. In cases in which vesical decompression, on account of a large residual urine on admission, is being carried out, one must wait until the apparatus is removed and the catheter draining the bladder empty before the phthalein test can be taken. It is essential that the patient drink water in large amounts, beginning one-half hour before obtaining the phthalein test, and that this be continued throughout the test. By this means it is possible to obtain the appearance time, and the half-hour readings, as has been shown before. These are both essential in order to obtain an accurate idea of the functional value of the kidneys, and to prepare a graphic phthalein excretion chart. As the case progresses, the renal studies should be carried out frequently in order to determine the result of treatment and the approach of an optimum time for operation. The same applies, of course, to the other diagnostic studies, which have been previously outlined.

THE DIFFERENTIAL DIAGNOSIS OF PROSTATIC OBSTRUCTION.

The severity of the symptoms does not depend upon the size of the prostate. We have seen many cases in which the prostate was no larger than normal, in which the obstruction was very great, and eventually a huge amount of residual urine, with finally complete retention developed. On the other hand, prostatic adenomata of huge size may cause little or no obstruction. In some of these cases the lateral lobes alone are involved. The absence of median hypertrophy often relieves any strain upon the trigone, which is thus able to open the vesical sphincter by pulling down the median portion without much resistance, and in consequence, does not hypertrophy (Fig. 355). As seen here, although the lateral lobes are greatly enlarged, and the urethra many times wider than normal, there is very little middle lobe, no hypertrophy of the trigone, and no trabeculation of the bladder. The adenomatous growth,

nodule or mass in the posterior lamella is at once recognized by the third degree induration and marked increase in thickness of the sub-urethral prostatic tissue. The symptoms of cancer are often exactly the same as those of hypertrophy especially in the early stages. Later pain localized and in the back hips thighs and legs should make one suspicious of carcinoma. A roentgen ray should be taken of course, to see whether metastases to the bones are present. The carcinomatous lesion is generally recognized by its very marked induration charted as third degree. Such a finding even though it be very small may make one suspect carcinoma and if impossible to make a diagnosis perineal operation in which the area may be seen palpated excised and subjected to microscopic study should be carried out. The roentgen ray is also valuable to differentiate between calculi and a cancerous nodule of the prostate.

Sarcoma.—As noted in another chapter sarcoma in the region of the prostate very rarely invades the urethra vesical neck or bladder. It almost never produces obstruction to urination until late but may produce frequency owing to the compression of the bladder from behind and reduction of its capacity. On examination in most cases the disease is found largely above the prostate involving only the upper portion. It is often entirely retrovesical with a prostate normal in feel below it. In rarer instances the entire prostate is invaded and the consistence softer than found in carcinoma or even in benign hypertrophy. As Ewing has shown anaplastic carcinoma may also present a very soft mass to the examining finger and even under the microscope the cells may resemble closely those of sarcoma. Occasionally the sarcomatous mass is found to be nodular and not of the usual great dimensions. In such cases the recognition of the malignant nature of the disease is practically impossible. In cases of abscess or cellular break down of the prostatic tissue the exact nature of the pathology may be impossible to recognize on rectal examination. Sarcoma of the prostate and its adnexa is usually such an extensive mass when first seen that diagnosis presents no difficulty. Cystoscopy and simultaneous rectal examination should be carried out in order to thoroughly evaluate the situation present.

Calculi.—Prostatic calculi have been studied in detail in another chapter. In the majority of cases of endogenous prostatic calculi no symptoms are produced for many years. In others irritation and pain in the posterior urethra associated with frequency of urination sometimes with definite obstruction may exactly simulate prostatic obstruction. On rectal examination the calculi are sometimes felt but more often they are impalpable and only suspected by the feeling of crepitus. In many cases this too is absent and the diagnosis can only be made by x rays taken by special technique so that the rays pass directly down the strait of the pelvis as previously described. Not infrequently the area of calculi may present a hard nodule or mass which exactly simulates carcinoma. Here again the roentgen ray furnishes the diagnosis. In calculi within the prostatic urethra—exogenous in type—

as ulcers, stones, diverticula, encysted calculi, tumors and tuberculous lesions are among the most common conditions, which may lead to errors in diagnosis. Unless careful cystoscopic examination is made, one cannot have an accurate idea of the conditions present, not only at the prostate orifice, but within the urethra, and the bladder. It is certainly indefensible to do prostatic surgery without careful cystoscopy. Two or three types of telescopes are desirable, in that one can then see behind prostatic bars and lobes, obtain an accurate idea of the elevation above the trigone, and the projection of the lateral lobes into the bladder, and their relation to the anterior and lateral vesical walls. If diverticula are present, it is frequently possible to introduce the cystoscopic beak within them, and determine their size, the presence or absence of inflammation, ulceration, calculi, tumors and whether the ureteral orifice opens within the diverticulum. In rare instances the diverticulum is huge and the bladder small, so that the diverticulum sometimes takes the part of the bladder in the collection and evacuation of urine. With the posterior cystoscope, a diagnosis can be made as to the type of intraurethral obstruction, and particularly the relation between these lobes and the verumontanum and external sphincter. Not infrequently enlarged lateral lobes crowd down upon the membranous urethra, so that their removal, especially with transurethral operations, requires the greatest care to prevent serious injury of the sphincter. The same thing applies to prostatectomy, perineal and suprapubic, in both of which the sphincter may be so seriously injured as to cause incontinence unless care be taken. While examining the posterior urethra, one should search for ulcers or papillary conditions which suggest carcinoma, and pockets which may contain inflammatory products or stones. It is most important to recognize the presence of both prostatitis and early benign hypertrophy. Not infrequently such cases come for operation, but treatment of the prostatitis and elimination of the purulent secretion by massage and instillations of 0.5 per cent mercurochrome or 5 per cent argyrol sometimes eliminates all urinary symptoms, and immediate need of operation. It is possible that it also causes a diminution in the size of the lobules and lessens the obstruction. It is often worth while to try such palliative methods. On the other hand, massage and instrumentation may increase the obstruction.

Cancer.—As indicated elsewhere, cancer of the prostate is apparently increasing as shown by the work of Rich and of Moore, and the statistics at our clinic as to the frequency of cancer in patients applying for treatment of urinary obstruction. In over 50 per cent of the cases, which have cancer of the prostate, there is present at the same time hypertrophied lobes, generally laterals and a median. These generally lie in front of the carcinomatous area in the posterior lamella. The presence of the adenomatous lobes may make the recognition of cancer difficult. The cystoscopic picture generally shows only the adenomatous lobes at the vesical orifice and within the urethra, but with the finger in the rectum, and cystoscope in the urethra, the carcinomatous

paradoxical incontinence. In this disease the sensory pathways to the bladder are injured so that the patient cannot know the state of vesical distention. The bladder muscle is greatly overstretched resulting in secondary atrophy. There is a question whether one should operate to remove the obstruction in such cases especially if incontinence is not present, and the obstruction not very marked. There are a limited number of cases in which enucleation of the lateral and median lobes through the perineum has been followed by excellent results in babies.

The symptoms of urgency and frequency of urination are commonly seen in neurological disease involving the motor tracts. Langworthy and Lewis have shown definite changes in cystometric readings in patients suffering from bilateral or unilateral hemiplegia paraplegia disseminated sclerosis etc involving different levels of the motor tracts. The bladder capacity is generally reduced. There is hypertonicity of the bladder musculature hyperactivity of the stretch reflex. Frequency in cases of bilateral hemiplegia may amount to true incontinence. These cases may be complicated by enlargement of the prostate with residual urine. Prostatectomy may be indicated.

THE TREATMENT OF PROSTATIC OBSTRUCTION

This depends on a great variety of conditions such as the type of obstruction the degree of obstruction, the amount of residual urine the results of back pressure the presence of infection the cardio-vascular system the seminal tract the neuro-psychic status the age of the patient and the general condition.

As stated before prostatic obstruction may be due not only to adenomatous hypertrophy but to many other conditions such as contractures of the vesical orifice bars valves at the prostatic orifice, valves springing from the verumontanum cysts projecting into the bladder or within the urethra cysts of the utricle prostatic calculi (exogenous and endogenous) areas of carcinoma tuberculosis prostatic abscess etc. Each of these may present a separate problem and require different medical and surgical treatment. The degree of the obstruction is also a very important determining factor as to treatment. If slight it may be advisable to do nothing, or to try local or general treatment. As the obstruction and associated symptoms become more pronounced the treatment to be employed may be progressively altered. Of great importance is the amount of residual urine present the back pressure effect upon the bladder and the kidneys the changes in the ureters pelvis calyces renal cortex kidney function blood chemistry etc. Other determining factors come from changes within the bladder (cellules diverticula stones ulcerations infection local or remote). The cardio-vascular condition is also of very great importance and with the development of high blood-pressure marked cardiac lesions concomitant anginal and cerebral symptoms the clinical picture and the treatment necessary may rapidly change.

they may be felt by rectum, and demonstrated by means of the roentgen-ray, the passage of instruments (cystoscopy, endoscopy, etc.) The presence of calculi in the tissues outside the hypertrophied lobe, and generally immediately beneath the posterior layer of prostatic tissue, in a considerable number of cases, furnishes another argument for perineal prostatectomy.

Tuberculosis.—Tuberculosis is rarely confined within the prostate. The seminal vesicles are generally the region markedly involved, and in most of the cases tuberculous epididymitis also accompanies it. In one-third of our cases, in which complete extirpation of the seminal tract was performed, one kidney was also involved and removed. The prostatic urethra and bladder may be involved in all types of genito-urinary tuberculosis, and furnish the principal symptoms of which the patient complains, dysuria, frequency, pyuria, hematuria, pyrexia, etc. Where the examining finger finds indurated areas and some enlargement of the lateral lobes and similar conditions in the seminal vesicles, tuberculosis should usually be suspected. In rare instances the tuberculous lesion involves only a portion of the prostate, and is of the same induration as carcinoma. In such it may be impossible to differentiate between the two conditions. Careful study of the urine, after cleansing the glans and urethra, and inoculation of guinea-pigs are often necessary to confirm the diagnosis of tuberculosis, and recognize this condition as being responsible for the symptoms of prostatic obstruction.

Neurological Lesions.—These may be accompanied by symptoms identical with those of prostatic obstruction—gradually increasing residual urine, frequency and difficulty of micturition, etc. Not infrequently symptoms typical of tabes—pain, ataxia, involvement of the rectal sphincter, etc.—are present, and may clear up the diagnosis. The prostate is often smaller than normal and the median notch and furrow often wide and deep. A cystogram will show this to be due to a dilatation of the internal sphincter, the prostatic urethra forming a funnel-shaped extension of the cystogram. If incontinence, generally paradoxical, is present, the external sphincter may seem to be dilated. Cystourethroscopy will usually show a tight external sphincter, and above it a dilated prostatic urethra, a wide open vesical neck, and a non-hypertrophied trigone. The bladder wall is usually atonic, thin, the muscle bundles fine and not hypertrophied, as in obstruction. The residual urine may be just as great as in the severest cases of prostatic obstruction, but it is usually accompanied by incontinence, which is much rarer in prostatic obstruction. A careful neurological examination, blood and spinal fluid tests, Wassermann, etc., will often clear up the diagnosis. Roentgen-rays of the spine are important in that they not infrequently show lesions of the sacrum and coccyx and deformities of the spinal column.

Neurological lesions of the brain and spinal cord frequently present symptoms suggesting vesical-neck obstruction. The cord bladder, as produced by tabes dorsalis may present symptoms of retention and

remedies to combat it. In blood-stream infections we have used mercurochrome 1 per cent intravenously with splendid results.¹ We have also found the use of water in large amounts 3000 to 4000 cc by mouth daily the best method of not only improving renal function keeping up the blood-pressure but also in flushing the urinary tract and avoiding infection. In many instances the patient will be found to have only moderate residual urine no impairment of the kidney function or cardio-vascular system, and in condition for operation at once. Nevertheless before anything is done water by mouth or other routes should be forced. Except in certain cardiac and vascular conditions it is wise not to have the patient confined to bed as he will often become stronger while up and about than while lying for a protracted period. If the blood studies show anemia this should be combated by dietetic methods and internal medication and if pronounced, by blood transfusions. These may be repeated if necessary to bring the hemoglobin to a fairly normal condition before operation. It may even be desirable to carry out blood transfusion on the morning of operation in order to combat shock and sometimes to begin a transfusion of glucose before or after making the incision in very bad cases.

During the stage of medical treatment the gastro-intestinal tract appetite diet etc. should receive expert attention. In the presence of nausea and the inability to take much food or water intravenous

¹ Piper first advocated the use of mercurochrome in doses of 5 mg. per kilogram of body weight in combating puerperal septicemia. He reported 3 cases. Since then we have used intravenous injections of mercurochrome in many forms of generalized and local infections with some amazing results. The drug has been found particularly effective in *B. coli* septicemia, and also but to a less extent, in staphylococcus blood-stream infections. A number of extraordinary cures of streptococcus septicemias have been reported along with many failures. In local conditions, such as boils and carbuncles, and other skin infections, many excellent results have been obtained. In staphylococcus infections of the urinary tract, neosarsphenamine may be more effective. Two or three doses, beginning with 0.3 gm., will often completely eradicate a severe blood-stream infection. It is also valuable in the treatment of deep-seated gonorrheal infections, but here mercurochrome seems to give somewhat better results. We do not now use the original dosage of mercurochrome (5 mg. per kilogram of body weight) but start generally in the adult with 12 cc. of a 1 per cent solution. The drug may be introduced in the same vein repeatedly without producing phlebitis. The injection is usually followed by a pronounced reaction, rise in temperature sometimes an increase of 4 to 6 F., nausea, vomiting and diarrhea. Somewhat similar reactions are produced by various other intravenous and intramuscular injections. I have never seen a reaction as severe as I have in some cases of blood transfusion. The effect we now believe is produced by stimulation of antibodies, and defense reactions, in which the fever may play an important part. Although it may make the blood bacteriostatic, it does not make it germicidal, as shown by Hill and Colston. The injection should be repeated at intervals of two three and four days, with an increase in the dosage of 2 to 3 cc. of a 1 per cent solution each time. One should look for gingivitis, and immediately stop the treatment for several days. Dysenteric stools may call for a cessation in treatment. The presence of albumin may also retard the treatment for a few days, but in thousands of injections we have never seen nephritis follow. In fact, we have frequently used the drug in cases of pyelonephritis, in which white and red blood cells and albumin were present, and with good results. There are other drugs which are also valuable in intravenous therapy. In our opinion, before long, the truth of Ehrlich's prognostication that some time in the future many infectious diseases would be treated successfully by chemotherapy will come to pass gloriously but not until an incomprehensible attitude toward all forms of intravenous therapy is finally eliminated from some important members of the medical profession.

The duration of treatment necessary before the patient can be brought into an optimum condition for operation varies considerably

On the arrival of the patient at the office or out-patient department, after a thorough history has been taken and carefully studied, one should proceed to study not only the type of obstruction present, but all complicating conditions which accompany it. Great age is a very serious complication. Whereas the mortality between sixty and seventy years is about the same as between fifty and sixty, after seventy-five the mortality of all procedures increases rapidly, and between eighty and ninety, is five to six times as great as between sixty and seventy years. Nevertheless, one cannot escape operating, even in the very aged. We have personally had a patient aged ninety-five years, and Arthur Cecil reports that he carried out perineal prostatectomy successfully in a patient aged ninety-nine years. In these very old men, the greatest care is necessary to get them into an optimum condition for operation by supportive treatment, cardiovascular remedies, catheterization, intermittent, or retained, if necessary on account of residual urine, the usual steps to combat renal impairment, infection, etc.

Percussion of the abdomen to determine the presence of considerable residual urine, as remarked before, is an important primary step. If considerable residual urine is discovered, a catheter should be passed and the pressure immediately determined, and if high, decompression carried out. This should be progressive and last over a period of twenty-four to forty-eight hours. During this period the patient is given water in large amounts to drink, and if necessary, infusions of salt solution beneath the breast or fascia lata or transfusions of glucose, 5 per cent, into some vein, preferably one of those around the ankle or foot. The important thing is to stimulate renal function and prevent suppression.

The phthalein test is obtained as soon as the residual urine and bladder capacity have been noted. In taking the phthalein test, the appearance time, the amount excreted in four successive half-hours is determined and charted. The phthalein test is repeated three times a week, or more often, if necessary. Estimations of the blood urea are made on admission, and if they reveal a retention of urea, repeated at intervals three times a week. These findings should also be charted. As stated before, comparison of the phthalein and blood urea curves form a most interesting study of the progress of the case. One generally sees a remarkable inverse parallelism, and can tell at a glance the approach of the optimum condition for operation. With these, one is able to quickly recognize changes in the condition, the need of additional treatment, or the use of other methods. The charting of the blood-pressure, which should be done daily, also furnishes an important comparison with the functional test. During this period every effort should be made to prevent infection by thorough antiseptic treatment, and if the onset of fever indicates that infection has occurred, one should determine, if possible, the focus and undertake the proper

kidney regions. The possibility of such occurrences shows the importance of frequent and careful local and abdominal examinations. During the continuance of bladder drainage through a perineal supra-pubic or urethral catheter general lavage of the bladder with small amounts of mild antiseptics boric acid potassium permanganate etc. should be carried out. After washing out the deposition of 5 to 10 cc. 5 per cent argyrol or 0.5 per cent mercurchrome may be effective in the prevention of stone incrustation upon the catheter or suprapubic tube. If possible the urine should be kept acid by appropriate means. With the advent of very alkaline or ammoniacal urine the profuse occurrence of mucus is accompanied by deposition of urinary salts incrustation on tubes formation of calculi in bladder cellules or diverticula and serious complications. Sodium acid phosphate 10 gr. t.i.d. by mouth and injections of acetic acid 2 per cent into wound and bladder may be helpful. Infection of the seminal vesicles also plays a very important part in the course of the disease. A fulminating epididymitis may produce a serious situation requiring evacuation. As a rule however elevation of the scrotum and application of an ice-bag is sufficient to cause a gradual disappearance of the epididymitis. If however the infection is accompanied by a good deal of prostration fever anemia and increasing weakness free drainage should be adopted in order to prevent generalized sepsis or great impairment of strength.

In résumé one must accentuate the fact that the period between examination and operation is one fraught with possibilities of dangerous complications but that with untiring vigilance vesical drainage renal and cardio-vascular therapy amazing benefit may be accomplished. Patients thought at first to be beyond surgical relief may often be brought to a condition so good that almost any operation may be carried out with success.

Hygienic Considerations.—The same general rules of hygiene apply to these elderly patients as apply to any condition of ill health in a man of mature years. It is especially important that the diet at all times should be mild fruit juices are distinctly beneficial. Chilling of the body wetting the feet violent exercise and in fact anything which would tend to increase congestion of the pelvic organs will cause an increase of the distressing symptoms. In the earlier stages the patient often is tempted to hold his urine longer than he should. This has very frequently been followed by acute retention and has led to the first introduction of a catheter. Out-of-door life moderate exercise a bland diet regularity of the bowels, regularity of meals abstinence from alcohol regular hours of sleep a constant protection of the abdomen and pelvis from sudden chilling—these are the most important details in the life of the patient with an enlarging prostate.

The treatment of the early stages of enlargement of the prostate resolve themselves almost entirely into treatment of urinary stasis. Later infections of the bladder and kidney appear and need to be dealt with.

glucose 5 per cent may for a time be effective. If the vomiting continues, the use of the duodenal tube may be of great value. By passing it through the nose, it may be retained for a long period without removal. In one of my cases, it required five weeks to conquer the vomiting and to get sufficient food and water to combat the serious general cardiac and renal conditions which were present.¹ It is absolutely amazing what can be accomplished by the methods outlined above. Patients who on admission are so desperately ill that consultants are apt to warn against any operative procedure, may be got eventually into a comparatively good condition, so that any operation required may be carried out without much danger or difficulty.

The use of the catheter requires much attention and skill. It should be introduced without traumatism. It should not produce vesical spasm or hemorrhage. It should be removed before serious urethritis or periurethral inflammation, infection, etc., occur. If the use of the retained catheter becomes difficult, painful or unsatisfactory, after repeated attempts with various instruments, one must consider other forms of drainage, if the condition of renal function, etc., indicates that the patient is not ready for operation. The usual practice is to carry out suprapubic drainage. In many clinics it is indeed quite common to insert a suprapubic drain as the first stage operation in most cases. Statistics, we believe, show conclusively that this is not wise practice, that the suprapubic operation carries with it a mortality varying from 1 to 10 per cent, according to the condition of the patient, the extent of infection, the clinic and the operator. We have found it necessary to carry out suprapubic drainage in not more than 2 to 3 per cent of the patients requiring operation for prostatic obstruction, and have recently found that where a catheter in the penile urethra is insupportable, a small incision through the bulbous urethra with the insertion of a catheter through the prostatic urethra into the bladder is well tolerated. It gives, in fact, better results than suprapubic drainage, which is not only uphill, but may be complicated by local and generalized infection. If a periurethral, periprostatic or perivesical abscess develops during the course of drainage, immediate attention should be given to prevent a generalization of the infection. Prompt incision, drainage, irrigation, packing, etc., is generally advisable. In the case of prostatic infection, it may be well, after thoroughly washing out the purulent material, to carry out prostatic enucleation. In other cases it may be well to wait a few days in order to operate through a cleaner wound. Should perivesicular and submuscular infections occur during the continuance of suprapubic drainage, liberal incision, inspection, evacuation and drainage should be provided. In rare instances the infection may travel upward in the sheaths of the recti muscles or between the peritoneum and posterior surface of the abdominal muscles. If recognizable, such conditions should be met surgically. The same applies to inflammatory extensions and extravasations, which sometimes occur upward and outward towards the

¹ Jour Am Med Assn, 94, 1830, 1930

provided its use is found to be unattended with any special trouble or discomfort

Intermittent Catheterism — As a temporary expedient to relieve an obstruction which may be expected to shortly disappear intermittent catheterism is simple and efficient. It has its dangers which consist first of possibilities of septic infection which while they may be reduced to a minimum by extreme care are nevertheless always present and in the peculiar conditions which surround patients suffering from urethral obstruction the necessary precautions are usually sooner or later imperfectly observed and the introduction of sepsis takes place. It is a matter of occasional observation however that certain individuals exhibit a marked immunity to the results of such infection indeed in some cases the use of an unclean catheter is persisted in for years with the production of only a very moderate amount of septic infection in the bladder. These cases however are so rare as to make more emphatic the statement that the continued use of a catheter is sure to result in a train of septic consequences of the most serious character. The majority of patients who elect to depend upon the continued use of the catheter for urinary relief enter upon a course which in itself progresses steadily to fatal termination within a brief period.

The second danger of attending the use of a catheter is the immediate constitutional reaction which in occasional instances has been observed to follow its use a reaction so profound in some cases as to terminate in death within a very few hours.

The third danger is referable to the local irritation, or traumatism with which its introduction is attended. As the result of this there is pain and constitutional disturbance, though of a lesser degree than has already been mentioned which follows each attempt at the introduction of the catheter. In those conditions of obstruction due to prostatic enlargement in which the question of catheter relief comes up for consideration the character of the obstruction is such as frequently to insure and accentuate the pains and difficulties just indicated. These difficulties may often be very greatly lessened or modified by the choice of the best model of an instrument or by skill in its introduction but in many cases even with the highest degree of skill and the best of instruments the local irritation incident to persistent attempts at the use of a catheter becomes so great as to be a serious element in the dangers of the case.

The Catheter à demeure — As a substitute for intermittent catheterism the permanent tying in place in the bladder of a catheter is to be considered. Its value has received the commendation of men of the highest authority. Practically however it is found that marked differences exist in individuals as to their ability to tolerate the presence in the urethra of the instrument. When it can be tolerated its use is free from the special difficulties and miseries incident to the continued frequent introduction of an instrument especially in those cases in which the introduction of an instrument is difficult. In the best of cases however there is a certain amount of irritation of the urethral mucosa

When the symptoms in the early stage are intensified by the incidence of congestion or inflammation of the prostate they may be dealt with by non-operative methods. This consists of relieving the congestion of the pelvic organs as much as possible, by administering enemata to empty the bowel, by repeated sitz baths, by hot rectal irrigations, by prostatic massage, and by the exhibition of such drugs as urotropin, benzoate of soda, santal oil and the various balsams.

Intra-urethral Methods of Treatment.—Dr Gardiner presented well this aspect of prostatic therapy in the last edition. As a palliative measure in enlargements of the prostate due to congestion and inflammatory processes, the catheter is frequently employed. Its uses in the early stages of a true hypertrophy of the prostate have already been referred to.

There are, however, a set of cases in which intra-urethral methods of treatment should be the methods of choice. These methods range from minor surgical procedures carried out through an endoscope, including the application of the high-frequency spark, to the more radical punch operation of Young and the more dangerous galvano-cautery operation of Bottini and the modification of this method advised by Chetwood. The cases in which these methods of treatment are called for are those which fall into the class already described under Urinary Obstruction without Hypertrophy of the Prostate, *i. e.*, submucous fibrosis, deformed orifice due to inflammation, and hyperplasia of the suburethral and subtrigonal group of glands.

The contra-indications to the more radical operation of prostatectomy are practically the same as those governing any major surgical operation in a patient of the same age.

We divide then our recommendations for treatment into four classes.

1 *Palliative treatment* in the prostatic enlargements due to congestive or inflammatory causes, also in the cases in which surgical operation is contra-indicated.

2 *Intra-urethral surgical treatment* in the cases of urinary obstruction without hypertrophy of the prostate.

3 *Suprapubic cystostomy*, as a preliminary step to prostatectomy, and as a permanent means of relieving retention of urine in cases in which prostatectomy is contra-indicated.

4 *Prostatectomy*, either perineal or suprapubic transvesical, in all cases of true hypertrophy of the prostate.

Palliative Treatment.—Why is this not justifiable in the cases of true prostatic hypertrophy? It may be tried as a temporary expedient, and then only in the early stages of the disease, but in the light of our present experience always under protest rather than as a measure possessing the full recommendation of the surgeon.

Doubtless in many cases operation on the first appearance of serious obstructive symptoms will be impracticable, either through the disinclination of the patient to submit to such an operation as prostatectomy, or his inability to give up from his occupation the time required for its performance and recovery thereupon. The catheter may be employed,

at its distal end, is connected with one arm of a Y-glass tube. The other arm of the Y tube is hooked over the edge of a receptacle hung at the foot of the bed. When all is connected the clamp is removed from the catheter and the height of the urine receptacle is adjusted to a level at which the urine will just trickle over into it on deep inspiration. The tube is clamped when the patient is fed, bathed, or when any movement is to be undertaken which will disturb the relative level of the bladder and the outlet. An ordinary douche pail makes a good receptacle since the accumulated urine may be removed by removing the stopper from the outlet without disturbing its level. The receptacle is lowered 2.5 cm. each day until the bladder has emptied itself or until the level of the outlet is approximately that of the bladder. When this level is reached the bladder is usually almost if not quite empty. However if 200 or 300 cc. of urine remain the intravesical pressure is reduced to *nil* and there is no danger in completing the emptying of the bladder.

Preliminary Operations.—1 **Those Operations Necessitated by Inability to Secure Satisfactory Drainage with a Urethral Catheter**—In my early work I employed only intermittent catheter drainage. Arthur Cecil who was my Resident Urologist at that time has continued this practice and he has one of the lowest mortalities in the history of perineal prostatectomy less than 1 per cent. It is sometimes very difficult to pass a catheter due to the great variety of conditions previously described. Catheterization every few hours or sufficiently frequent to prevent overdistention and back pressure effects upon the upper urinary tract may be impossible. On this account the use of an inlying catheter has become almost universal. Often drainage through an inlying catheter is entirely satisfactory. The patient has no discomfort, drainage is quite perfect and the progress of the patient entirely satisfactory. In other instances it is difficult to get the catheter properly adjusted. There may be pain, bleeding. Removal on account of blood clots may be required, suppuration around the prostate and urethra may make immediate removal of the catheter necessary. As stated before while a catheter remains in the urethra for continuous drainage the greatest care should be taken to prevent infection both of the bladder and urethra. A search for periurethral and periprostatic abscesses should be made frequently as these may lead to serious blood stream infections, pyelonephritis, etc. When the use of a catheter, either intermittent or permanent, becomes unsatisfactory in the presence of considerable residual urine and danger of back pressure the surgeon is confronted with the question of what should be the next step.

Suprapubic Aspiration of the Bladder—In rare instances if the renal function is good suprapubic puncture with a small needle and aspiration of the bladder contents may be satisfactory to tide over the emergencies in which it was impossible to pass a catheter. After one aspiration the congestion may be relieved and the patient may void naturally or a catheter may be passed easily. There are in-

which attends its presence in the urethra, a moderate urethritis is produced. The irritation of the deep urethra is of special consequence in this connection, if, as seems to be well substantiated, there is any special nervous relation between this portion of the urethra and the secretory apparatus of the kidneys. One of the alarming results which

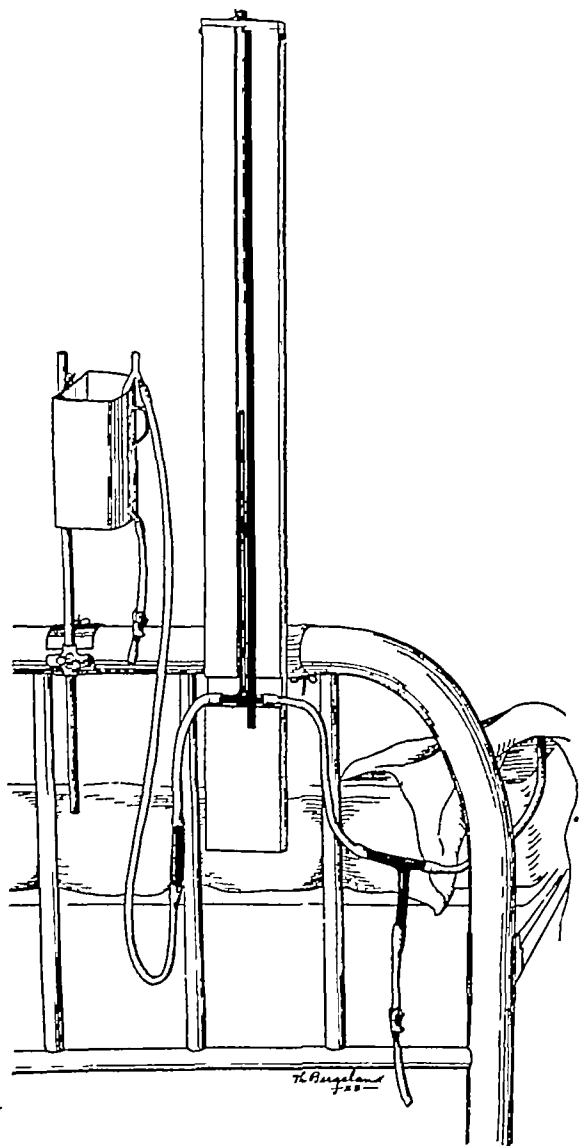


FIG 385 —Simple method of gradually emptying a chronic distended bladder

attend the second group of dangers connected with the use of the catheter, already alluded to, is anuria directly dependent upon the irritation of the deep urethra, caused by the use of a catheter. This reflex effect upon the renal secretory apparatus must be kept in mind in determining the propriety of introducing or maintaining a permanent urethral catheter. This must be of special importance in those cases in which reflex renal disturbances dependent upon urethral and bladder conditions have already been demonstrated. It is in this last group of cases more particularly that, as a substitute for a permanent urethral catheter, the opening of the bladder above the pubis and the securing within the opening of a suitable drain to relieve the urethra entirely suggests itself.

The Gradual Withdrawal of Residual Urine —An ingenious method described by Van Zwalenburg, has been used at the Mayo Clinic since January 1, 1921.

Method of Application —The patient is placed in a hospital and made comfortable in a warm bed. A soft rubber catheter is introduced with all aseptic precautions and fastened in place without permitting the escape of any urine. This procedure is possible except in occasional cases in which the catheter has to be passed on a metal guide. In these cases a minimum loss of urine occurs, usually from 10 cc to 15 cc. The catheter is then connected to a 6-foot rubber tube, which

hours in order to avoid a sudden drop in blood-pressure, suppression of urine, hemorrhage into the urinary tract etc. as described elsewhere.

Frank Kidd of London devised an ingenious instrument for providing vesical drainage without infection of the suprapubic wound.¹ After exposing the bladder a Malecot rubber tube was inserted through the anterior wall of the bladder by means of a stylet equipped with a knife at the tip of the obturator passing through the tip of the catheter. On withdrawal of the stylet the catheter was opened. The incision in the bladder was therefore smaller than the drainage tube which allowed no leakage of urine.

Another technique was that advocated by Nelf and also by Heves. This consisted of a small suprapubic incision, exposure of a small area of vesical wall and insertion of a gauze pack. There was a lapse of several days during which the wound was supposed to have become walled off, after which an opening was made in the bladder and a drainage tube inserted, effort being made to have a tight fit so that there would be little or no leakage into the previously formed suprapubic tract. The object of this procedure, as described by its proponents, is to prevent that very frequent and dangerous complication of suprapubic drainage *viz.* prevesical infection, extravasation beneath the muscles and peritoneum, generalized sepsis, etc.

Suprapubic drainage as usually performed begins with a median incision 3 to 6 cm. in length, separation of the recti muscles, dislocation of the peritoneum upward, incision of the prevesical fascia, excellent exposure of the bladder wall to be certain that no peritoneum intervenes and puncture into the bladder. Most operators have thought it advisable to insert the finger, obtain an accurate idea of the prostatic obstruction, the type, size and location of the various lobes, the condition of the vesical orifice, the determination whether prostatectomy or a punch operation upon a median bar or vesical neck contracture would suffice, search of the bladder for stones, diverticula, tumors, trigonal hypertrophy that might produce obstruction, hour-glass bladder and other pathological conditions. A tube was then inserted, the bladder closed tightly around it, the suprapubic wound approximated with silver wire so as to bring together fascia, muscles and skin and prevent intramuscular extravasation. Suprapubic gauze drain to take care of prevesical leakage or infection was also supplied.

It was in 1898 that we first saw the marvelous results that might be obtained by suprapubic drainage in a desperate case of uremia. The patient was unconscious, his bladder greatly overdistended and catheterization was impossible. Dr. Bloodgood made a suprapubic incision and inserted a drain. This was followed by a crisis in which the patient had suppression and almost died, but by means of internal hydrotherapy, cardiac stimulants, etc., he gradually came out of his uremia and rapidly improved in strength so that within a month I was able to carry out a suprapubic prostatectomy, the first performed in the

stances in which suprapubic puncture has been repeated many times. One operator reported that he had used it one hundred times in the same case. With the presence of infection suprapubic puncture is not an entirely safe procedure.

Some twenty years ago von Bergman attempted to produce a sigmoid suprapubic tract, which would have a valvular action, and allow urine to escape only intermittently when the abdominal muscles were put in action. I happened to be present when one of these operations was carried out. The procedure consisted in plunging the trocar through the skin into the rectus fascia, then traveling down the rectus until the prevesical space was reached, and plunging it directly into the distended bladder. Through this trocar a tube was inserted into the bladder and kept there until a solid walled sinus was produced. The tube was then withdrawn and the suprapubic "sigmoid sinus" was supposed to furnish an intermittent escape for the urine, which would be operated by muscular contraction. Two days later, in the autopsy room, I saw the same patient. The trocar had gone well beyond the rectus muscle, and punctured two loops of intestine before entering the bladder.

Many years previous to this Hunter McGuire had produced a sigmoid suprapubic sinus by an open operation. After carrying out the usual suprapubic cystotomy, and introducing the rubber drainage tube, he brought it beneath the rectus muscle, and out at an entirely different level from that in which he made the cystotomy. This was left in place until a sinus was formed, and the patient able to void urine at will through this sigmoid sinus. No such danger attended its formation, as in the case of von Bergman's method, which appeared years later.

About 1895 the Bloodgood bag was in vogue. This consisted of a rubber bag much like a small hot-water bottle, which was fastened by its side to a gutta-percha suprapubic tube. The bag was strapped around the waist. The patient wore this on the front of his abdomen, and evacuated it periodically. Very satisfactory drainage was thus obtained. Other apparatus, by means of which suprapubic drainage tubes may be connected with rubber bags worn down the leg, or simply emptied intermittently are the methods usually employed if long continued drainage is necessary.

Suprapubic drainage, by the simple insertion of a trocar through the skin into the bladder without any attempt to produce a sigmoid sphincter-like tract has long been practised by occasional operators. Lower is still an advocate of this method. The bladder must be fully distended. A trocar, which will carry a fair-sized catheter, is plunged through the skin and muscles just above the pubic bones into the bladder. The obturator is withdrawn, and a catheter inserted. If the distention is great, one should not evacuate the bladder, but obtain the intravesical pressure, attach a decompression apparatus, and fix the outlet only a few centimeters below the intravesical pressure. The outlet should be gradually lowered in the course of the next twenty-four to thirty-six

suprapubic drainage and the second prostatectomy performed as soon after the first operation as the condition of the patient permits. If performed before much cicatrization occurs the suprapubic wound facilitates the operation of suprapubic enucleation. If done some weeks after the suprapubic drainage operation the necessity to incise excise or at any rate greatly enlarge the old sinus certainly makes suprapubic prostatectomy more difficult. It has been our practice in such cases to consider such an old sinus an indication for enucleating the prostate through the perineum.

Urethrostomy Through the Bulbous Urethra—It has been our practice in some cases in which an indwelling urethral catheter was not well borne by the patient or was followed by complications as above described to make an incision through the bulbous urethra and insert through it a catheter directly into the prostatic urethra and into the bladder. This procedure can be carried out in the patient's bed if necessary under local anesthesia. The urethra is rapidly opened upon a sound and a catheter inserted. Drainage through a perineal urethrotomy has the advantage that it avoids completely any danger of extravasation and sepsis which so frequently follows suprapubic drainage. The patient can also be allowed to leave his bed and walk, and is not confined to his back for a prolonged period. The down-hill drainage has proved more satisfactory than the uphill suprapubic tube. In some very severe cases with great impairment of renal function severe cardio-vascular conditions have eventually reached a condition in which perineal prostatectomy could be successfully carried out.

During the Period of Drainage the Therapy is Varied—The whole procedure depends entirely on the condition of the patient. One must first determine the condition of the kidneys, the cardio-vascular system, the blood chemistry and the general strength of the patient. Great age also plays a very important part. As indicated elsewhere the bladder should always be percussed before being emptied by urethral catheterization, suprapubic or perineal drainage. If considerably distended the bladder should not be emptied as stated before and the vesical pressure or intravesical tension obtained before allowing any urine to escape. If the residual urine is not great say 300 cc. and the bladder not percussible above the pubes the bladder may be emptied completely by means of a catheter or at cystoscopy and a determination made as to whether an indwelling catheter should be employed. If the phthalein test shows good function this is confirmed by a normal blood urea and if the cardio-vascular and general condition is good operation may be undertaken without delay. If however these examinations show the necessity for continuing drainage the patient should be given appropriate internal treatment consisting of hydrotherapy, water in large amount by mouth or by rectum, subcutaneous, intravenous injections of salt solution or glucose being preferable.

Supportive measures for the heart of which digitalis and morphia

Johns Hopkins Hospital, Baltimore, Md. There was a huge middle lobe present, and I had great difficulty in enucleating with my finger the deeper intra-prostatic portion of the hypertrophy. An Irish orderly suggested that he insert his finger, push up the prostatic mass, and assist me in getting it out. I took his hint, and inserted my own gloved finger into the rectum. This bi-digital, recto-vesical method of enucleation was subsequently, at my instance, described by Guiteras in a paper in "Prostatectomy in America" at the 1900 International Congress of Medicine in Paris. Freyer happened to be present, as he had just read a paper on litholapaxy. Three months later he published cases in which he had employed this technique, but forgot to mention its American origin. In fact he described it as a method, original with him. In numerous other publications he demonstrated the great value of suprapubic prostatectomy and the "Freyer method" by the self-same technique is now regarded all over Europe as the method of choice.

[The operation of Freyer was directly copied from the operation of Fuller, a clear account of which was first published in 1895. There can be no doubt that the priority of this relatively complete operation belongs to Fuller and not to Freyer.—EDITOR.]

The postoperative treatment in cases which have been subjected to suprapubic operation for drainage requires great care. The bladder should be irrigated, but only with such small amounts as to avoid extravasation. The gauze drain should be removed in a few days, and frequent examination of the prevesical space and the flanks to see whether extravasation or deep-seated suppuration is occurring. At the same time, every effort should be made to keep the kidneys functioning, and if possible, to improve them. Water in large amount by mouth, rectum, beneath the skin (salt solution intravenously) glucose and even blood transfusions may be desirable.

In the presence of such severe uremia that nausea and vomiting are constant, a tube inserted into the stomach, or preferably into the duodenum affords a chance to give water and liquid food. During this time frequent estimations of the phthalein excretion and the blood urea should be made to gauge the condition of the patient and note the improvement from day to day. It is amazing what can be accomplished by drainage through a catheter or a suprapubic drainage tube.

The Dangers of Suprapubic Drainage—Volumes have been written on this subject, and the estimate of its dangers has varied greatly. Gardiner considered that the mortality of simple suprapubic drainage in cases of enlarged prostate was about 3 per cent. In other clinics it is distinctly less. At one of the great metropolitan public hospitals, in which indigent patients are said to come *in extremis*, the general mortality after suprapubic drainage was figured at 15 per cent or more. In private patients the same operators had a far less mortality. Nevertheless, suprapubic drainage has to be considered a definite risk, and in my opinion to be avoided if possible. There are others who maintain that most prostatectomies should be done in two stages, the first being

suprapubic drainage and the second prostatectomy performed as soon after the first operation as the condition of the patient permits. If performed before much cicatrization occurs the suprapubic wound facilitates the operation of suprapubic enucleation. If done some weeks after the suprapubic drainage operation the necessity to incise excise or at any rate greatly enlarge the old sinus certainly makes suprapubic prostatectomy more difficult. It has been our practice in such cases to consider such an old sinus an indication for enucleating the prostate through the perineum.

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Supportive measures for the heart of which digitalis and morphia

are among the most important, are generally given under the direction (in severe cases) of an internist accustomed to handling prostatic conditions in the aged. In the accompanying charts (Figs 378 and 380) are shown the condition indicated by these tests on entrance, their progress, the optimum arrived at and the results of operations. As shown here, amazing results may be obtained by a combination of the various therapeutic methods previously described. Patients who have arrived at the clinic in stuporous uremia with only a trace of phthalein excreted in three to four hours, with a blood urea mounting to 200 mg per 100 cc, and with high blood-pressure and severe cardio-vascular disturbance, have been brought to an optimum condition of renal stabilization which, although far from perfect, was sufficiently good to allow perineal prostatectomy to be carried out successfully.

Hugh Cabot in studying the mechanism of the protection afforded by the drainage of prostatics as a preliminary to operation has observed certain phenomena which lead him to conclude that "the relief appears to be the result of two factors (1) Relief of the so-called 'back-pressure' with the equalization of the kidney circulation thus resulting, and (2) lessening of infection which though long believed to be chiefly a cystitis, is now generally regarded as in fact a pyelonephritis." He states further "No discussion is necessary to establish the now generally accepted view that the custom of preliminary drainage before operations for prostatic obstruction has been an important factor in reducing the mortality. Much obscurity, however, surrounds the reasons for the benefit thus produced and it is with this subject that we are here concerned. The importance of preliminary drainage is by no means equal in the various classes of cases presenting themselves for operation. It will probably be generally admitted that preliminary treatment, of which drainage is the most important constituent, is most essential in the class of patients who come to us with largely overdistended bladders, sometimes stretched to the point of overflow but in whom infection has not yet occurred. We all remember the dreadful mortality which accompanied the attempt to empty the bladder and remove the obstruction immediately upon coming under observation. It is notorious that these cases did badly from the start and died generally with the symptom-complex which we somewhat loosely call uremia. Perhaps the next most lethal proceeding was to operate at once upon those cases with a moderate residual of from 6 to 12 ounces and a still uninfected urine, while immediate operation was least hazardous in those cases with a moderate residual thoroughly infected and best typified by the patients who had for some time been leading the so-called catheter life. The extremes are represented by the overdistended uninfected bladder and the thoroughly infected but regularly emptied bladder enjoying a catheter life."

The Surgical Problem — We cannot do better than to reprint in this third edition the descriptions and opinions of the distinguished author of this chapter in the second edition, the late Dr James A

Gardner To state the case in its simplest terms the problem presented in obstructive lesions of the prostate is

- 1 To provide a free exit for the urine from the bladder
- 2 To permanently remove the obstruction at the neck of the bladder
- 3 To preserve the sphincter vesicæ, and if possible the ejaculatory ducts.
- 4 To prevent postoperative shock and hemorrhage
- 5 To prevent infection and sloughing
- 6 To secure rapid healing of wound and the reëstablishment of the normal functions.

The Choice of Operation — Intra-urethral methods of operation are indicated in the cases of obstruction due to submucous fibrosis bar formations of inflammatory origin and obstructions due to hyperplasia of the suburethral and subtrigonal glands. In the remaining cases there are but two methods of operation to be considered namely perineal and suprapubic transvesical prostatectomy. So much has already been written concerning the relative merits of each that a full discussion of the subject is not necessary. It is safe to say that the majority of surgeons have adopted the suprapubic transvesical method. In the hands of a few specially trained men there is practically no choice between the two methods judging from the mortality records and the character of the end-results. But this does not hold good when we consider the results of the operation in the hands of the general surgeon to whom the major portion of the work comes.

Perineal prostatectomy is an operation for the expert only. The present authors of this chapter cannot agree to this statement. We have found in the training of hospital residents in urology that as soon as they have learned the anatomy and technique they perform the operation of perineal prostatectomy very well. In fact at this moment, their mortality on the public ward cases is better than any of the older men on their private patients. We are reprinting Dr Gardner's views as expressed in the second edition so that the suprapubic advocates may be well represented. Suprapubic prostatectomy is an operation *per se* which can be easily performed by the majority of surgeons. In the latter operation the chances of accident are less and the certainty of completely removing the obstruction is greater than when perineal prostatectomy is attempted by a surgeon who is not specially trained in the surgery of this region. Many men encouraged by the brilliant results of a few who popularized the perineal operation attempted the operation and brought discredit to it by their failures. The same is true to a lesser degree of the suprapubic operation. The fact is that success in removing prostatic obstructions depends upon a fundamental knowledge of the pathology of the disease not only as it affects the prostate itself but more especially as it affects the bladder and ureters and kidneys. The mortality percentage in a given series of cases does not depend upon the particular type of operation employed but it does depend upon the individual surgeon who performs the

operation, his preoperative study of the case, his ability to anticipate the dangers before they arise, and his skill in meeting the emergencies as they occur

Some expert urologists who operate upon the majority of these cases by the suprapubic route still employ the perineal route in those cases where the obstruction is caused by a small fibrous prostate. Practically all surgeons agree that the suprapubic operation is preferable in those cases in which there is a massive intravesical overgrowth of the gland. Many surgeons perform suprapubic prostatectomy in two stages, the first operation consisting of a cystostomy with drainage of the bladder, the second operation, enucleation of the prostate through the existing cystostomy opening. Other surgeons complete the operation in one stage. Experience and a proper consideration of the individual case should always guide the operator.

*Removal of Obstructing Growths per Urethram*¹—Dr. Gardiner continues, "attempts to remove the obstruction at the neck of the bladder by means of instruments introduced and operated through the urethra date back for over a century. The sum total of the experience gained during that period and especially during the past twenty years is, that no permanent relief can be gained excepting in the cases of the irregular forms of obstruction which we have described under the heading Submucous Fibrosis, Bar Formations Due to Chronic Inflammatory Changes, and Obstructions Due to Hyperplasia of the Suburethral and Subtrigonal Glands."

"In dealing with these types we have a choice of various methods. Destruction of the obstruction by means of the galvanocautery knife, or the high-frequency spark, or actual removal of the tissue by means of an instrument which punches out the tissue. Mercier, in 1839, devised the first instrument for actually excising portions of the growth, improving his technique and adding a blade for simply cutting through a median obstruction. Bottini, in 1874, introduced his method of division and incision of the prostatic obstruction by means of a galvanocautery instrument, hoping by this method to avoid the hemorrhage which was so dangerous a complication of the Mercier method. These surgical procedures were extensively tried, modified, and improved, and were the methods of choice until the present techniques of perineal and suprapubic prostatectomy were introduced, then it was demonstrated that the operation of complete removal of the diseased portion of the prostate was just as safe as these partial expedients, and the results were far more satisfactory and lasting. The result has been that most of these operations conducted *per urethram* have been discarded in the cases of true hypertrophy of the prostate. There still is a limited field, *to wit*, in the irregular forms of obstruction, for the the partial excision and electric-spark destruction."

Punch Operation — We continue to reprint Dr. Gardiner's opinions in the previous edition. "In 1909, Hugh H. Young devised an instru-

¹ For an extended history and description of this method see Deaver's "Enlargement of the Prostate," Philadelphia, P. Blakiston's Son & Co., p. 176, 1905.

ment which he calls *The Punch* by means of which the prostatic bars (Fig 386) can be removed through the urethra under local anesthesia. The first instrument presented was a urethroscope with light holder and attempts were made to remove the median bar, or other structures at the vesical neck under visual direction but experience showed that while it was possible to see the bar which was entrapped in the fenestra of the instrument and to observe the first cut the hemorrhage which followed effectually prevented observation of the succeeding cuts. As subsequent experience has shown that the operation can be very efficiently and accurately performed without visual direction the light carrier has been dispensed with. As at present carried out the operation is as follows. The instrument consists of an outer tube with a fenestra on the side (see Fig 387) and an inner tube with a sharp cutting end which fills the fenestra entirely until it is partially withdrawn which is used to excise tissue that may drop into the fenestra. An obturator is also provided but not often employed.

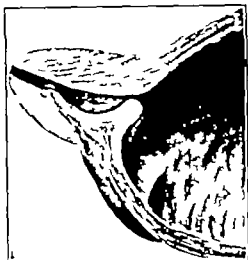


FIG. 386.—Longitudinal section showing a typical median bar elevated above the trigone without enlargement of the prostate.

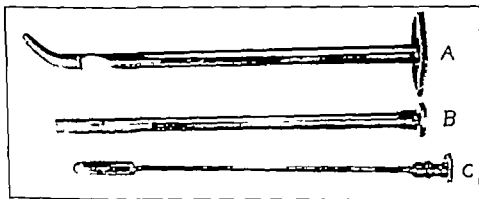


FIG. 387.—Young's prostatic bar excisor or punch. A outer tube and fenestra. C obturator. B inner cutting tube.

The technique of operation is as follows. Local anesthesia is usually employed 4 per cent novocaine in urethra and bladder inserted with a catheter which is later used to fill the bladder with fluid. The patient also receives $\frac{1}{4}$ gr. of morphia hypodermically and under this anesthesia the operation can usually be carried out with little pain. The instrument which is of No. 20 French caliber and provided with

a short curved beak, can usually be introduced without difficulty. It is carried well into the bladder (Fig 388) and the inner cutting tube withdrawn about 1 inch, thus uncovering the fenestra and allowing the fluid to escape from the bladder. The instrument is then rapidly

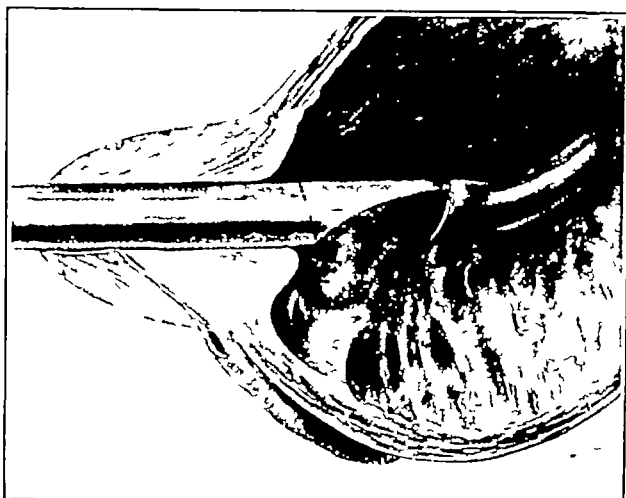


FIG 388 —The "punch" instrument has been introduced well into the bladder and the inner tube drawn upward, thus opening the fenestra through which urine begins to escape. The median bar is seen depressed by the shaft of the instrument.

drawn outward and as the fenestra comes into the urethra and the prostatic bar or contracture immediately drops into the fenestra (Fig 387), the operator then simply pushes home the sharp inner cutting tube which excises the bar which is within the fenestra (Fig 389). With

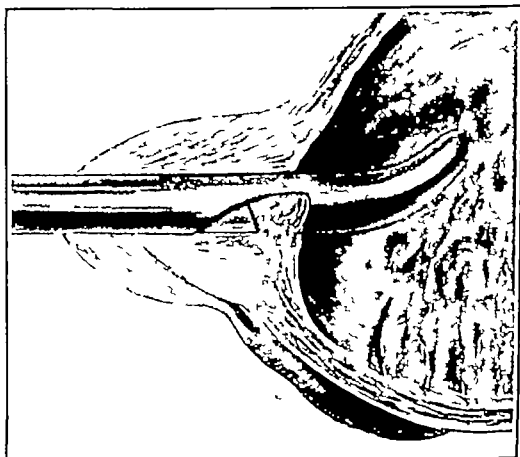


FIG 389 —The cutting inner tube is seen excising the median bar.

alligator forceps the tissue excised is quickly withdrawn from the interior of the instrument (Fig 390) and inspected. As a rule more than one cut is desirable and the operator turns the instrument in the desired direction and, following the technique above described, promptly

entraps and excises the tissues at the vesical neck in the desired directions.

In the majority of instances the posterior portion of the prostate is alone involved and consists of a fibrous or inflammatory glandular

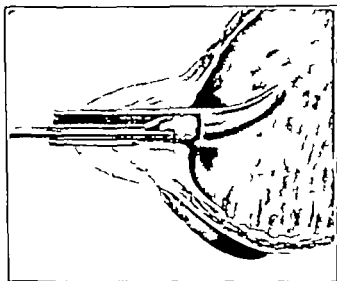


FIG. 300.—Sectional view showing the removal of the excised mass of prostatic tissue with urethroscopic clamps

enlargement of small size, which is easily caught by the fenestra of the instrument, which is about $1\frac{1}{2}$ cm in length. One cut posteriorly is usually made first. The effects of the removal of this section (Fig 301) is that the instrument immediately drops to the bottom of the cut, and as it is desirable to excise more of the median bar on each side this is done by turning the instrument directly to the left and then to the right, and by repeating the procedure above described thus excising the left and right ends of the median bar which was partly removed by the posterior median cut. In some instances anterior valves or bars are seen with the cystoscope and if present should be removed first. If the posterior cut is made first and the instrument drops into it greater difficulty is experienced in entrapping an anterior bar or valve. It is desirable occasionally to remove the lateral margins of the prostate. This was particularly true in cases where there was a general contracture but Young now thinks that such

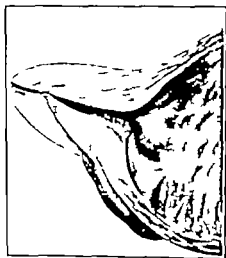


FIG. 301.—Sagittal section of prostate after excision of median bar

extensive excision is not necessary and that as a rule the removal of the median portion with three cuts is sufficient. There is usually fairly acute hemorrhage for a time and this is evacuated best through the punch instrument by means of a large syringe, with which the bladder is filled several times with fluids and the clots evacuated. A single large coude gum catheter is then inserted into the bladder (Fig 392) which is again washed free from blood and the catheter fastened in place with strips of adhesive. Young's "Punch" operation can usually be done in a very few minutes and the actual cutting causes very little pain owing to the speed with which it is accomplished, and as a considerable amount of tissue is removed the operation is really very radical, and thoroughly adequate for the type of case for which it should be reserved, namely, fibrous contractures of the vesical orifice, bars or small rounded posterior lobes consisting of fibrous

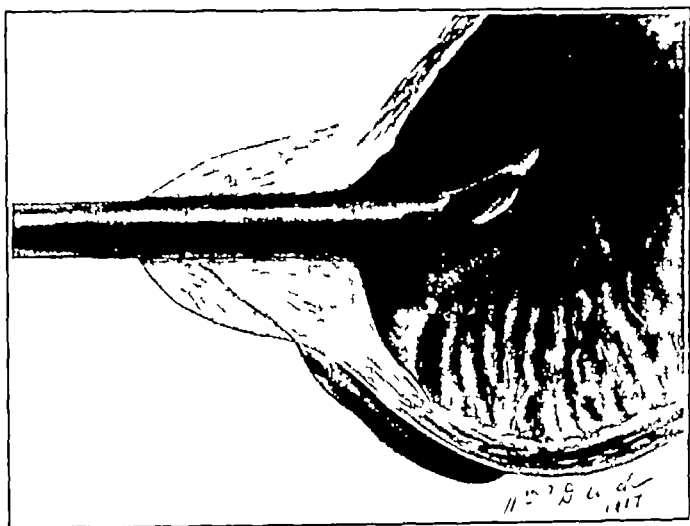


FIG 392 — Drainage of bladder with large catheter, No 28, after removal of the prostatic bar or contracture

or inflammatory glandular enlargement of the median portion of the prostate

"In the presence of lateral lobe or definite median lobe hypertrophy this operation should not be done, as removal of the median obstruction leaves the lateral lobes to continue the obstruction in generally increased amounts, so that careful study should be made with the cystoscope, and particularly with examination of the median and lateral portions of the prostate by finger in the rectum while the cystoscope is in the urethra to determine the presence of an hypertrophied collar or definite median and lateral hypertrophy of the prostate

"Young had also constructed a cautery punch, in 1911, which was supplied also with a stream of water to prevent overheating the outer tube (See Fig 393, photograph of instrument made in 1911) As seen here the inner cutting tube consists of iridoplatinum which

is superheated by an electric current. When the prostatic bar has been entrapped the electric current is turned on and after waiting a few seconds the cautery tube is slowly carried home by turning the outside screw mechanism. The effect is to burn away a block of tissue which fills the fenestra of the instrument and this is done quickly and absolutely without hemorrhage. There remains of course, a small area of charred tissue at the prostate orifice and this must naturally separate and crumble away with the patient's convalescence. A similar number of cuts can be made with this instrument as with the simple cutting punch instrument and has this distinct advantage namely in that hemorrhage is entirely absent and a urethral catheter is not necessary.

In 1920 J. R. Caulk presented a simple form of cautery punch which he had independently devised and used. This is not provided with an irrigation to keep the outer tube cool as he has demonstrated that this is unnecessary. His article strongly urges the use of the cautery punch instead of the simple punch and has forcibly called

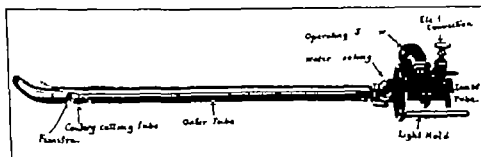


FIG. 703.—Photographic side view of cautery punch with water-cooling device which was designed by Young and made by Loewenstein, in Berlin, in 1911.

attention to this modification of the original operation. A personal report from McKim states that the use of the cautery punch has in some instances led to the deposits of urinary salts and small calculi upon the eschar at the site of the cautery burns in the prostatic orifice.

Subsequent treatment of the simple punch operation consists in maintaining a catheter drainage for several days during which time the patient is given water in large quantities and if the catheter becomes plugged with blood clots as it often does during the first two or three days these are removed by means of suction with a large syringe accompanied by introduction of water to wash out the bladder. Occasionally rather severe hemorrhages are encountered but in a series of over 200 cases Young had no deaths and the hemorrhage has always been taken care of by evacuation of the clots, occasional instillation of adrenalin into the bladder and the use of infusions and transfusions if necessary. In two instances other surgeons have found it desirable to carry out suprapubic drainage and pack at the prostatic orifice on account of hemorrhage. One of these was a case of tuberculosis of the bladder and the other of cyst at the vesical orifice. But even if

suprapubic drainage is occasionally desirable or necessary it adds very little to the gravity of the operation and without the punch operation it would probably always have to be employed in removal of the median bar "

As to results obtained, a careful study of cases has shown that this simple operation is really very radical and entirely satisfactory in removing the difficulty of urination, the hesitation, the small stream and the frequency of urination which is so often present in these cases. In some instances complete retention of urine was present but this was rare and in the majority of cases the residual urine was from 25 to 100 cc in amount, and was usually associated with contracture of the bladder, which almost always completely disappeared as the obstruction to urination and the consequent hypertrophy of the bladder muscles disappear.

Present Method of Using Young's Punch — There is very little to change in Gardiner's excellent description of excision of the prostatic bar, as performed at the present time at the Brady Urological Institute. The arrest of hemorrhage here, as with other transurethral operations, has been a cause of concern. Although there are no deaths from hemorrhage, there have been many cases in which the bleeding was troublesome. Frequent evacuation of clots from the bladder by means of powerful syringes have been not infrequently necessary, and rarely, a secondary hemorrhage occurred to give similar trouble. On this account the plan was adopted of introducing a ureter catheter cystoscope immediately after the completion of the punch operation. By means of an electrode the coagulating spark was applied to the bleeding points. With a stream of fluid flowing into the bladder, little difficulty was experienced in finding both the oozing and spurting vessels, and stopping the hemorrhage accurately in this way without deep destruction of tissue. By means of this technique we have been able to avoid doing a suprapubic cystotomy for evacuation of clots, or arrest of the hemorrhage except in one case. In a few other cases, quite a little trouble was experienced in coagulating the bleeding points satisfactorily, but the use of a large catheter, blood transfusion, coagulin, etc., has so far been entirely successful, and the bleeding has finally ceased. In nearly 600 cases the mortality has been less than 1 per cent.

Another problem in the use of the prostatic excisor or "punch" has been to secure larger amounts of tissue with each cut. At first the plan of rotating the inner cutting tube with the thumb and finger, while pushing it in to cut, was employed. Then an inclined plane was used, by means of which as the tube was pushed in, it was made to rotate. Then a small motor was attached to the inner tube by means of which the tube was revolved as it was pushed forward. By these means distinctly more tissue was excised, and if an attempt was made to get a slightly hypertrophied lateral lobe, a definite amount of tissue otherwise unobtainable, was cut away. Our "cautery punch" also secured tissue from the lateral lobes that might escape the "cold cutting tube."

It then occurred to us that by spearing the portion to be removed more tissue could be drawn into the fenestra as the cutting tube was pushed inward and finally an angulated spear which could be rotated so as to draw still more tissue into the fenestra was employed. In this way the excised pieces were much larger. Caulk has shown however in his great collection of cases operated by transurethral surgery, that suprapubic drainage has been necessary in a few cases, generally on account of uncontrollable hemorrhage and in a few others for better drainage. The rare use therefore of suprapubic cystostomy for drainage and cauterization of the wound in connection with the punch operation is not to be considered at all remarkable but quite a usual practice in all transurethral surgery.

After an experience of over 600 personal cases I (H. H. Y.) am of the opinion that the prostatic excisor with a sharp cutting inner tube is a most effective way of removing obstructions at the vesical neck due to contractures, bars, valves and median hypertrophies. For very large hypertrophy of the prostate it is still considered here to be inferior to perineal prostatectomy. The great advantage of the so-called cold cut is that the wound is clean, little or no necrosis is produced by the fulguration as compared with electric resection and the chance for severe bacterial infection is greatly lessened. In fact there have been no cases of gangrene or sloughing, no cases of periprostatic or perivesical infiltration, suppuration or extravasation, no cases of rectal injury or postoperative recto-urethral or recto-vesical fistula and only one case of incontinence. In this case several days later there was postoperative hemorrhage. The punch was inserted and in it a spiral wire cautery. This was brought to a red heat and applied to the wound in the vesical neck. The patient moved violently as a result of pain and cauterization of the membranous urethra occurred. This was found later to have extended into the muscle of the external sphincter with resultant incontinence but this we believe is the only case of incontinence in over 600 cases whereas we have seen a good many cases and heard of many more which follow transurethral electric resection. Such cases must have been due also to cauterization of the external sphincter.

The technique now employed by us is with a punch instrument that carries on its posterior surface a minute tube through which a delicate long needle can be passed (Fig. 304) for the injection of novocain into the margins of the prostate. The instrument is introduced the cutting tube withdrawn as the vesical fluid begins to escape the outer tube is drawn outward until the prostatic margin is entrapped in the fenestrum. An injection is first made say into the right lateral margin. The needle is then withdrawn 3 cm. the instrument turned 45 degrees and an injection made into the median portion of the prostate and thus around the entire orifice until infiltration anesthesia with novocain has been accomplished throughout the vesical neck.

The punch operation is then carried out, the first cut being lateral. After the tissue on one side has dropped into the fenestra a straight

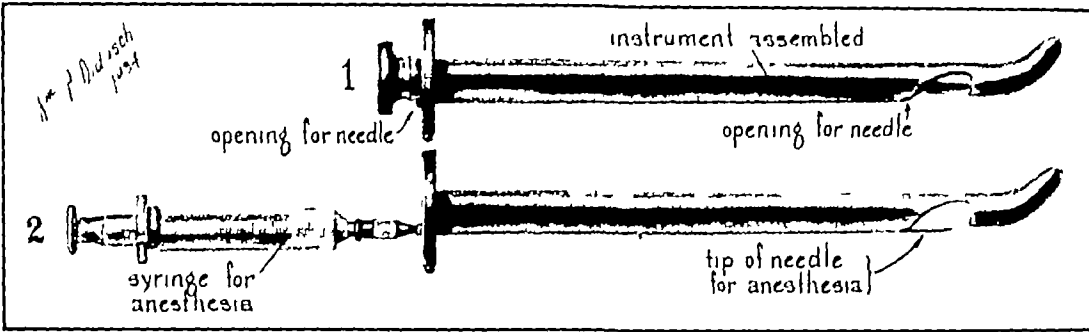


FIG 304

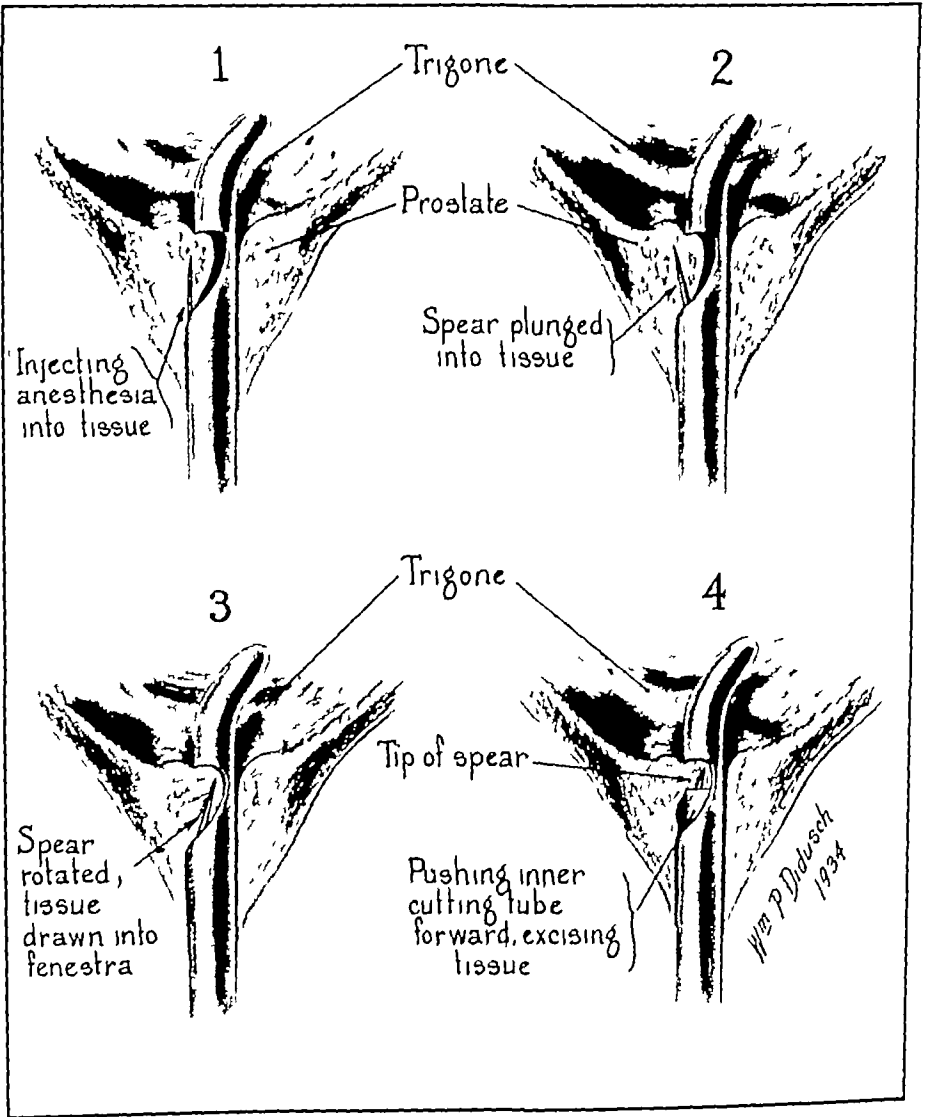


FIG 305

spear is introduced to hold it in place while the inner cutting tube is pushed home. The excised portion is extracted, the instrument turned posteriorly a few degrees and a second lateral cut made. This is repeated on the opposite side. Then it is turned posteriorly and the median portion of the prostate entrapped. In order to be certain that the trigone has not been caught the instrument is turned 90 degrees, traction made and then returned to the posterior surface with only the median lobe surely caught in the fenestra. This is excised leaving a deep wound in which the instrument at once drops. This is easily understandable if we consider the natural curve of the urethra and the effect of the triangular ligament in carrying the instrument into the bladder firmly against the posterior margin. It is turned to the right side and the



FIG. 396



FIG. 397

handle elevated so as to hold it in the posterior cut while the inner cutting tube is pushed in quickly to remove the right end of the median bar (Fig. 395). It is then turned 180 degrees to remove the left end of the median bar. In this way 7 pieces are excised (Figs. 396 and 397). Such is usually the technique we now employ with our prostatic excisor familiarly known as the punch. In many cases in which there is present only a contracture of the vesical orifice or small median bar one cut directed posteriorly and then one on each

side to remove the ends of the median bar, is entirely sufficient. In some cases the anterior prostatic margin is markedly rounded, and probably obstructive, either in the form of a bar or a valve. It has been our practice to remove this by a single cut. It is important not to cut too deeply anteriorly with any type of transurethral operation, because the anterior commissure of the prostate is not very thick, and the distance between the urethra and prevesical space not great, so that multiple cuts in this direction may enter the space, and produce hemorrhage, extravasation and infection. Our attention has been called to this particularly in the case of a confrère, who, in removing a cyst of the superior margin of the prostate, made numerous cuts and encountered the prevesical hemorrhage and extravasation as described above. The same has followed transurethral resections which were directed anteriorly. In many cases we now employ spinal anesthesia with pantocain, mg. 20.

Résumé.—We are still convinced that in transurethral surgery, by means of our prostatic excisor, we have the safest method of attacking conditions for which it was originally offered; viz contractures, bars, valves, median hypertrophies, valves of the posterior urethra in children, and other such conditions. The cuts may be guided by a cystoscope in the tube or a light carrier externally. Although it is possible with the cautery punch, which we introduced in 1911, to remove large lobes by repeated cuts of the lateral and median lobes, and although Caulk has shown that, with his modification and simplification of our instrument, he has been very successful, we are still convinced that perineal prostatectomy is better in large hypertrophies, and has a lower mortality, as will be given in detail further on. We believe that with the clean enucleation of lateral, median and other lobes, one has the ability to obtain hemostasis, adequate drainage by an open wound, through which thorough antiseptic treatment may be applied to combat infection, which has been so serious, particularly after transurethral electric resection.

The High-frequency Spark Operation —Dr. Gardiner continues. This form of treatment is applicable in the same class of cases as the Young's punch operation. The spark operation is less trying for the patient, and eliminates almost entirely the danger of hemorrhage. The patient is prepared as for a cystoscopic examination. A catheterizing cystoscope of small size, or a cysto-urethroscope is used. With the instrument in place, the obstructing mass is brought into view and the electric wire is advanced until it engages the tissue. Then the spark is applied for a period of from twenty to thirty seconds, or until the tissue shows destructive effect of the spark, dependent, of course, on the strength of the current. The spark is applied along parallel lines, reaching well across the obstruction. It is best to be cautious with the first application, doing too little rather than too much. After a period of two weeks, the cystoscope is again introduced, the effect observed, and further treatment applied. Considerable improvement should follow after the fourth or fifth treatment."

Bugbee who has treated a number of cases by this method, has published the following conclusions

The residual urine has been eliminated in all cases of median bar obstructions, as well as those due to cicatrix and chronic inflammation of the vesical neck

Partial relief was obtained in cases of incomplete prostatectomies with nodules of prostate remaining about the vesical neck

Of the patients with glandular hyperplasia 9 in number 3 have died of intercurrent disease 2 are symptomatically relieved 3 are still under treatment In 8 of the 9 treated the residual urine was lessened In one case there was no improvement

The cases of lateral lobe enlargement have shown little improvement These results bear out the belief of the writer that the high-frequency current should be reserved for the cases of submucous fibrosis and enlargements due to chronic inflammatory changes alone

TECHNIQUE OF PERINEAL PROSTATECTOMY

The early work in this country was all through a median perineal incision but since 1903 when Young published his first article on conservative prostatectomy, the inverted V or curved incision has been most usually employed

The preoperative treatment consists of water in large amount catheter drainage and an enema several hours before operation and morphia one-half hour before operation (see previous remarks)

The patient should be placed in an exaggerated lithotomy position with the pelvis elevated and the legs held by special supports so that the plane of the perineum is as nearly horizontal as possible. This and the following paragraphs were written for Dr Gardiner and are not changed here (II II Y) Imperfect position has led to the greatest difficulty in carrying out the operation The Halsted perineal board, which is placed at an incline on the table and has vertical posts to draw back the legs gives an excellent position but recently a special urological operating table with adjustable leg supports and an automatic perineal elevator has been introduced by which a splendid exposure can be very quickly obtained Without a good position perineal prostatectomy is a much more difficult operation

When the patient is in proper position the genitalia as well as the perineum and buttocks having been sterilized either with weak tincture of iodine or a solution of potassium mercuric iodide (which has the advantage of not being irritating) and the urethra having been injected with some antiseptic solution a No. 24 sound is passed by the operator until he is certain that the beak is well within the prostatic urethra when the handle of the sound is given to an assistant The perineal incision is then made and in order to best take advantage of the space between the ischiopubic rami and back of the triangular ligament, this incision should be somewhat of an inverted U the apex being 1½ inches in front of the anus and the two branches running backward

within the ischiopubic rami for a distance of about 2 inches on each side (Fig 398). This incision is carried through skin, fat and subcutaneous fascia and the posterior part of the bulb exposed but not opened. By blunt dissection with the finger and handle of the scalpel the space behind the transversus perinei muscles on each side of the central tendon and in front of the levator ani muscles is opened up, as shown in Fig 399. In introducing the finger great care is taken that it shall

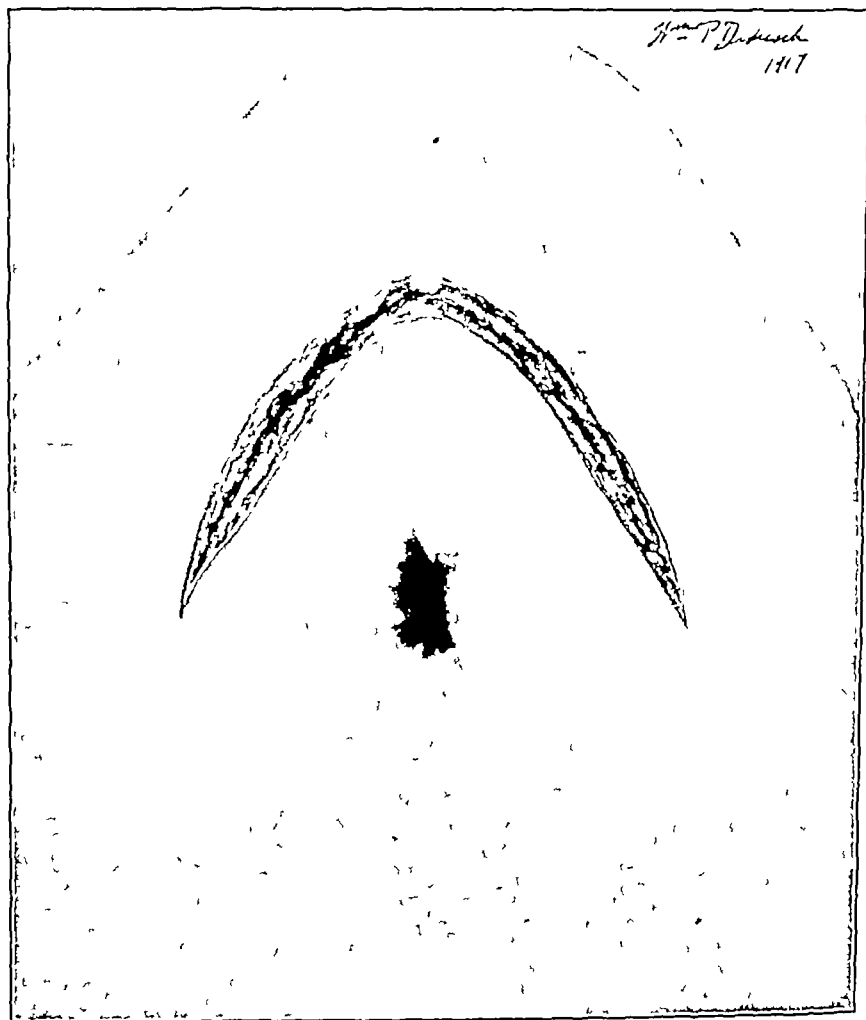


FIG. 398 — Perineal incision used for prostatectomy, radical excision of carcinoma and excision of tuberculosis of seminal vesicles

be directed slightly upward and forward so as to avoid going toward the rectum, the operator being sure that the line of dissection is back of the triangular ligament on each side.

The lateral spaces having thus been opened up, a special bifid retractor facilitates the next step by making traction upon the central tendon and thus drawing the bulb well up into view and at the same time pushing the rectum back out of the way. The operator then cuts across the central tendon close to its attachment anteriorly

(Fig 400) to the bulb until the region of the recto-urethralis muscle is reached. At this point it is best to remove the bifid retractor which is no longer essential and insert a small simple retractor (without a posterior lip which might injure the rectum) and thus make taut the recto-urethralis muscle which running from the rectum to the

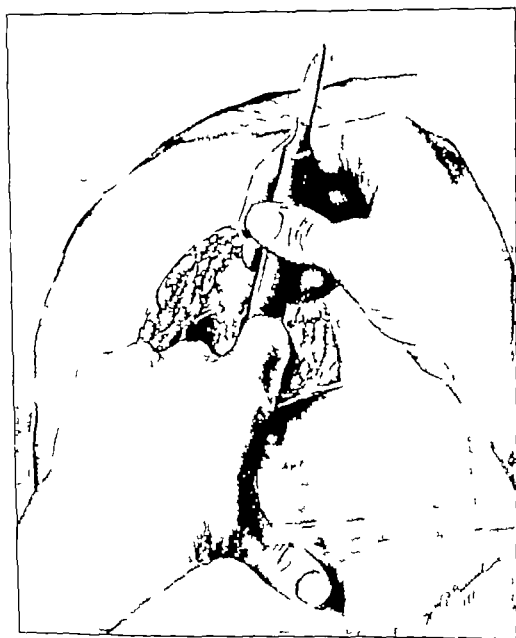


FIG 399 — Opening up the space on each side of the central tendon by blunt dissection.

membranous urethra and triangular ligament produces the anterior pouch of the rectum. This muscle covers the membranous urethra and great care must be taken to get a good exposure and to divide the muscle well forward so as to avoid any injury to the rectum which can thus be pushed backward by blunt dissection with the handle of the

within the ischiopubic ramus for a distance of about 2 inches on each side (Fig 398) This incision is carried through skin, fat and subcutaneous fascia and the posterior part of the bulb exposed but not opened By blunt dissection with the finger and handle of the scalpel the space behind the transversus perinei muscles on each side of the central tendon and in front of the levator ani muscles is opened up, as shown in Fig 399 In introducing the finger great care is taken that it shall



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The edges of the urethrotomy wound are then picked up with special toothed forceps which do not crush the urethra (Allis clamps) the operator being certain that the mucous membrane is engaged after which the sound is removed from the urethra. A straight sound is passed through the urethrotomy wound into the bladder (to make

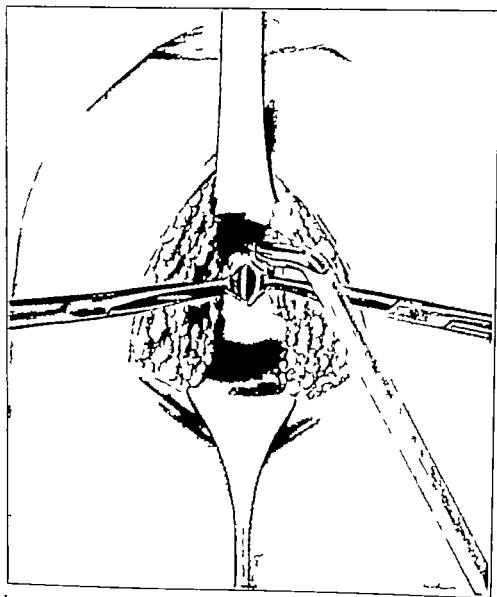


FIG. 401.—Prostatic urethra exposed, incised longitudinally upon sound, and edges picked up with non-crushing mucosa clamps. Prostatic tractor ready for insertion.

sure that the passage is clear) The prostatic tractor (Fig. 402) is then introduced through the urethrotomy wound into the bladder opened out and traction made. In this way the prostate is brought much closer to the perineum and an inspection will generally show that it is still covered by a fibromuscular layer through which it is necessary to go before the capsule of the prostate is reached.

scalpel, exposing the membranous urethra and apex of the prostate. By the use of a special grooved retractor, which is so constructed as to encircle the membranous urethra, anterior traction draws forward the triangular ligament and most of the muscular fibers of the external sphincter. With care the operator is able to push forward the remain-

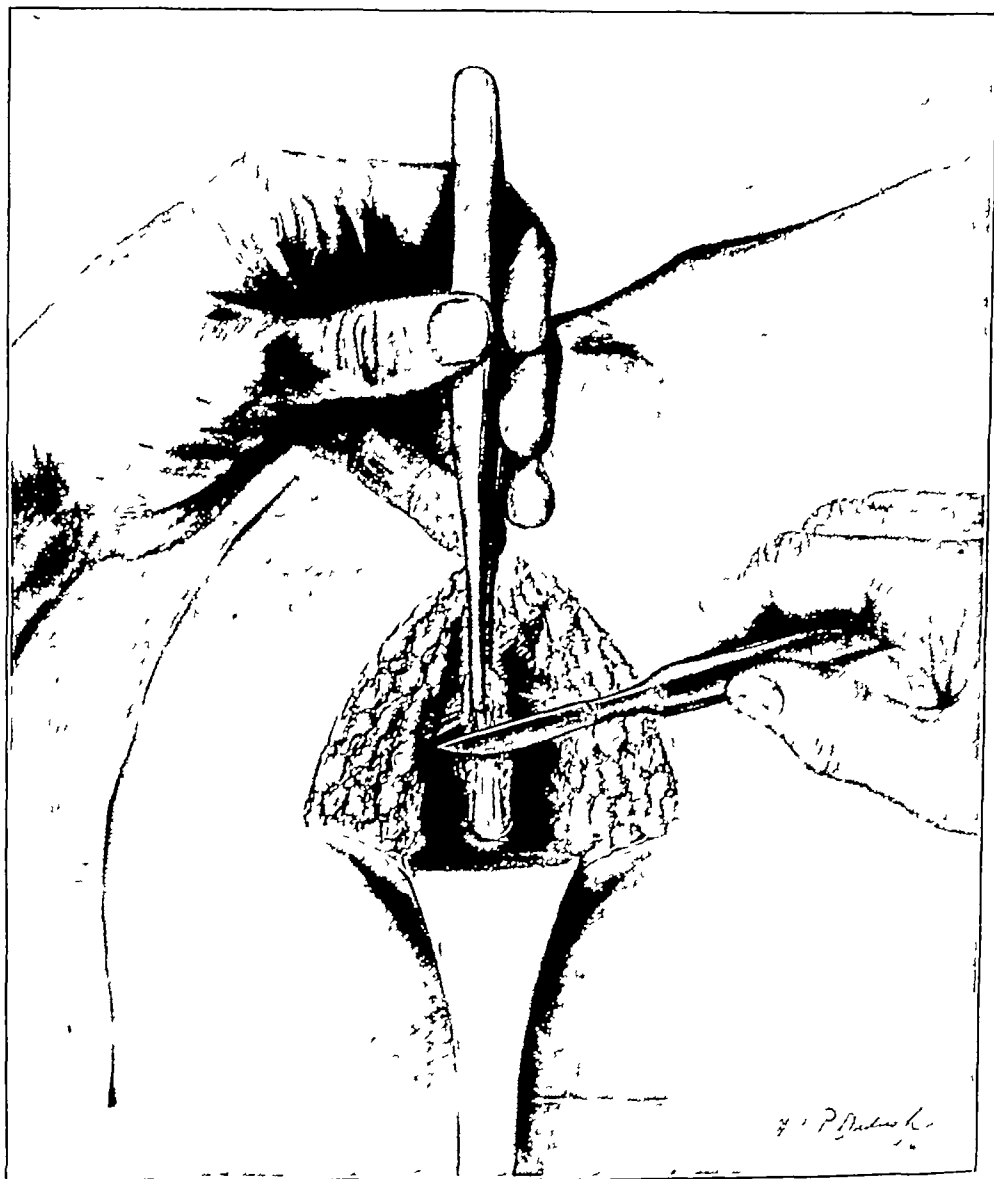


FIG. 400 — Bifid retractor inserted—division of central tendon

ing circular muscle fibers and to push backward the rectum sufficiently so as to expose a small area of the apex of the prostate and to make an incision upon the urethral sound through the membranous urethra where it joins the prostate, thus carrying out a urethrotomy entirely behind the external sphincter and effectively guarding against post-operative incontinence (Fig. 401)

front of the posterior layer of Denonvillier's fascia and levator muscles and traction made thus drawing backward the rectum with the central tendon and the recto-urethralis and levator ani muscles on each side

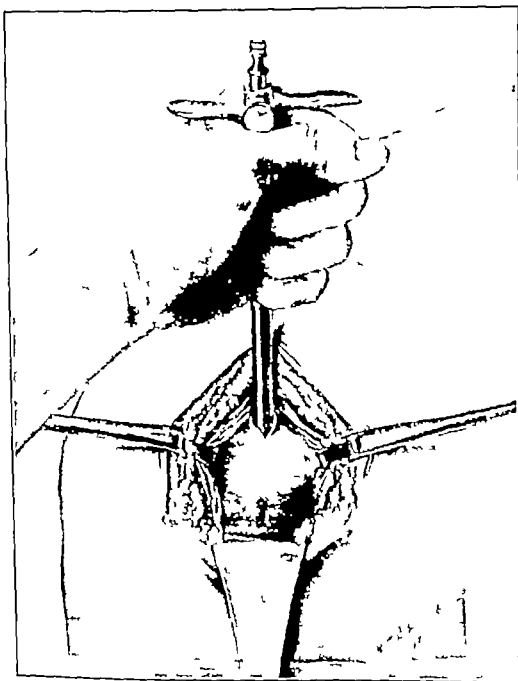


FIG. 403.—Tractor has been inserted and opened; posterior surface of prostate exposed showing anterior layer of fascia of Denonvillier.

By the use of narrow lateral retractors an excellent view of the entire posterior surface of the prostate can now be obtained (Fig. 403) and if it is necessary to see the region of the seminal vesicles by further

It will be remembered that in fetal life the peritoneum extends down almost to the perineum, but subsequently these two layers become approximated and the space obliterated up to the region of the seminal vesicles. These two layers of prenatal peritoneum, now approximated, form what is known as the anterior and posterior layers of Denonvillier's fascia and between them lies the route for the proper exposure of the posterior surface of the prostate and seminal vesicles. This part of the operation is the most important as to detail, for if the operator does not satisfactorily divide the posterior layer of fascia and attempts to push the rectum back before so doing, it is not difficult to penetrate the rectum, and practically all injuries of the rectum are due to such failure in technique.

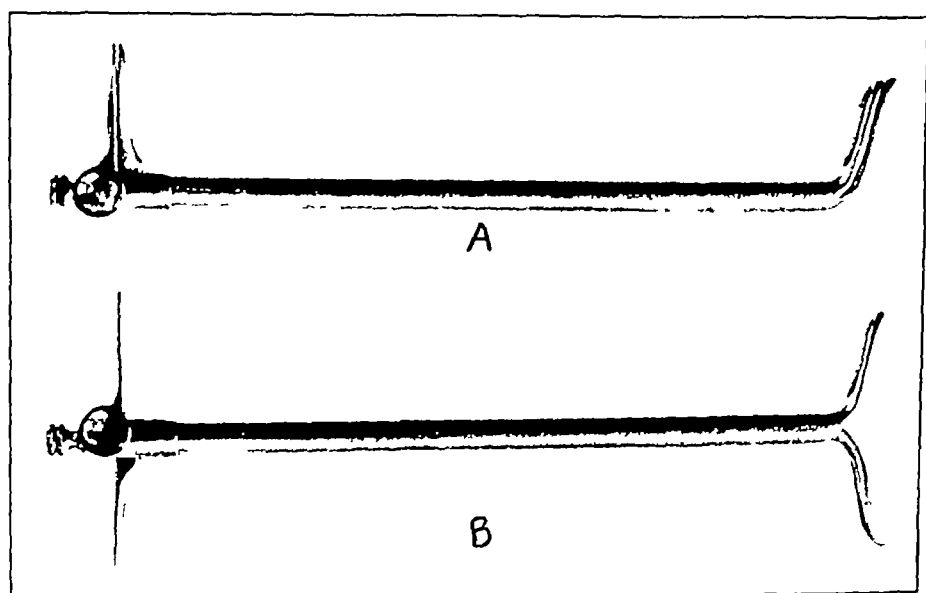


FIG 402 —A, Young's prostatic tractor closed, before insertion into membranous urethra, B, prostatic tractor opened, after entering bladder

In order, therefore, to be sufficiently careful, it is wise at this point while drawing the prostate up into the wound with the tractor, to make an incision on each side upon the apex of the prostate and push back the tissues carefully until the pearly-white anterior layer of Denonvillier's fascia, which closely covers and in reality forms the principal part of the prostatic capsule, is reached. As soon as it is exposed on either side it is quite easy to follow this white covering of the prostate across to the other side and to divide fibers running to the rectum, which is then very easily pushed backward by blunt dissection. The operator should be careful to work with the handle of the scalpel and subsequently with his finger, upon the surface of the prostate and not to press forcibly against the rectum. However, the latter is protected by the posterior layer of Denonvillier's fascia if the technique has been properly observed. A posterior retractor, which is slightly curved, not too deep and has no posterior lip, is then carefully introduced in

their injury may lead. It is important also to preserve in as normal a condition as possible the internal or vesical sphincter. In his earlier publications Young insisted on the importance of preserving if possible the entire prostatic urethra intact and for this purpose devised bilateral capsular incisions which passed through the posterior capsule and posterior lobe parallel to the urethra as shown in Fig. 401 exposing on each side the whitish capsule of the hypertrophied lobe the

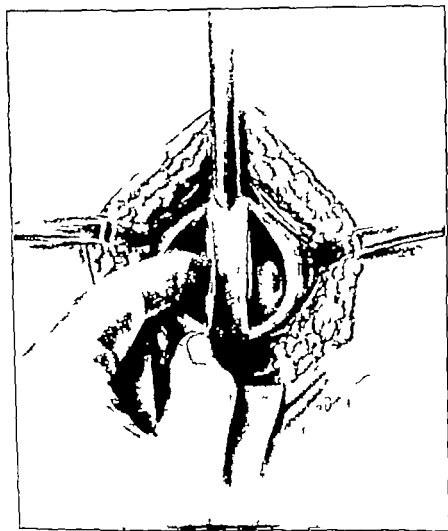


FIG. 403.—After removal of both lateral lobes the median is drawn down with tractor and pushed into left lateral cavity with index finger in the opposite cavity previous to enucleation of middle lobe.

enucleation of which is then commenced with a blunt dissector and followed with the finger removing entirely each lateral lobe. The median portion of the prostate then remains and it is usually possible by turning the blade of the tractor in the bladder 90 degrees to catch and draw down into the wound of the lateral cavities the median lobe where under inspection it is usually enucleated without difficulty (Fig. 404). In many instances it is found possible to remove a middle

blunt dissection on each side this can be accomplished. The seminal vesicles are occasionally the seat of abscess which should be exposed and evacuated. Boyd has shown that seminal vesiculitis has been responsible for failure to cure patients of pain, fever, etc., by operations on the prostate. The same applies to calculi which may involve the vesicles, ampullæ and intervening tissues.

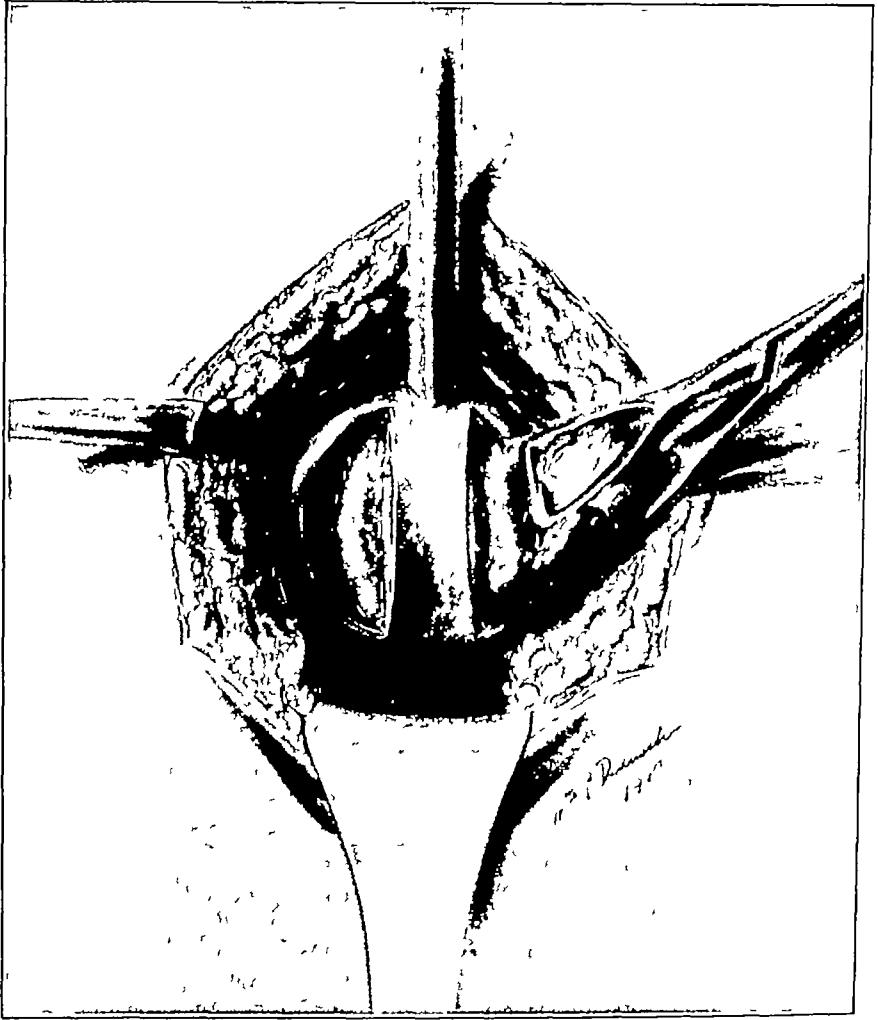


FIG 404 — Prostate exposed through an inverted V skin-incision. Tractor introduced, capsule incised on each side of median line. Enucleation of left lateral lobe partially completed.

The prostate is now drawn well down into view so that the operator is free to carry out any method of excision and enucleation that he may fancy. Up to this point the operation has avoided the following important anatomical and physiological structures. The hemorrhagic bulb, Cowper's glands, triangular ligament and external sphincter, and the rectum posteriorly. The next important structures to preserve are the verumontanum and ejaculatory ducts, not only on account of their sexual importance but also in order to avoid epididymitis to which

the operation with a lithotomy scoop to see if any calculus is present. If the calculus is large it may be necessary to dilate or even divide the vesical sphincter to facilitate its removal but in numerous cases calculi 4 to and even 6 cm. in diameter have been removed through the perineum without difficulty.

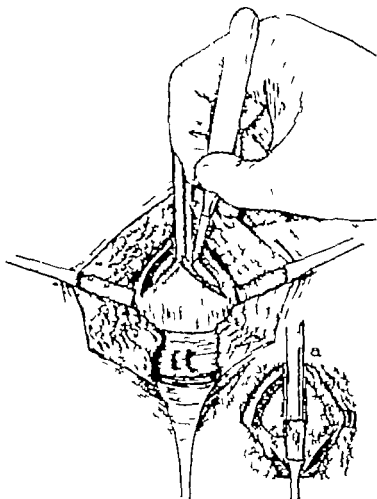


FIG. 407.—Division of the left wall of the urethra with scalpel. This is carried out also on the right side thus making it possible to draw down the triangular flap with forceps and expose the floor of the urethra and ejaculatory ducts, as shown in insert *a* in which the urethra is divided on each side the fold carried downward and the lateral adenomas exposed.

By the technique described above the operator may remove the lateral and intravesical hypertrophied lobes or bars with little or no injury to the mucous membrane of the urethra and with preservation of the verumontanum ejaculatory ducts and vesical sphincter. Young has called attention to the fact that after an extensive experience with some 900 cases in which the technique above described was used a study of the cases and ultimate results had shown that in many instances the mucous membrane of the urethra had been

lobe along with one of the lateral lobes, thus enucleating the entire hypertrophied prostate in two pieces. In some cases, where the median portion is very fibrous or intravesically pedunculated, this is difficult to remove and it is found necessary to introduce the finger into the bladder, generally after division of one lateral wall of the urethra, in order to successfully invert the middle lobe into the wound of the lateral cavities, where it can be enucleated by blunt dissection or with a sharp curette (Fig 406)

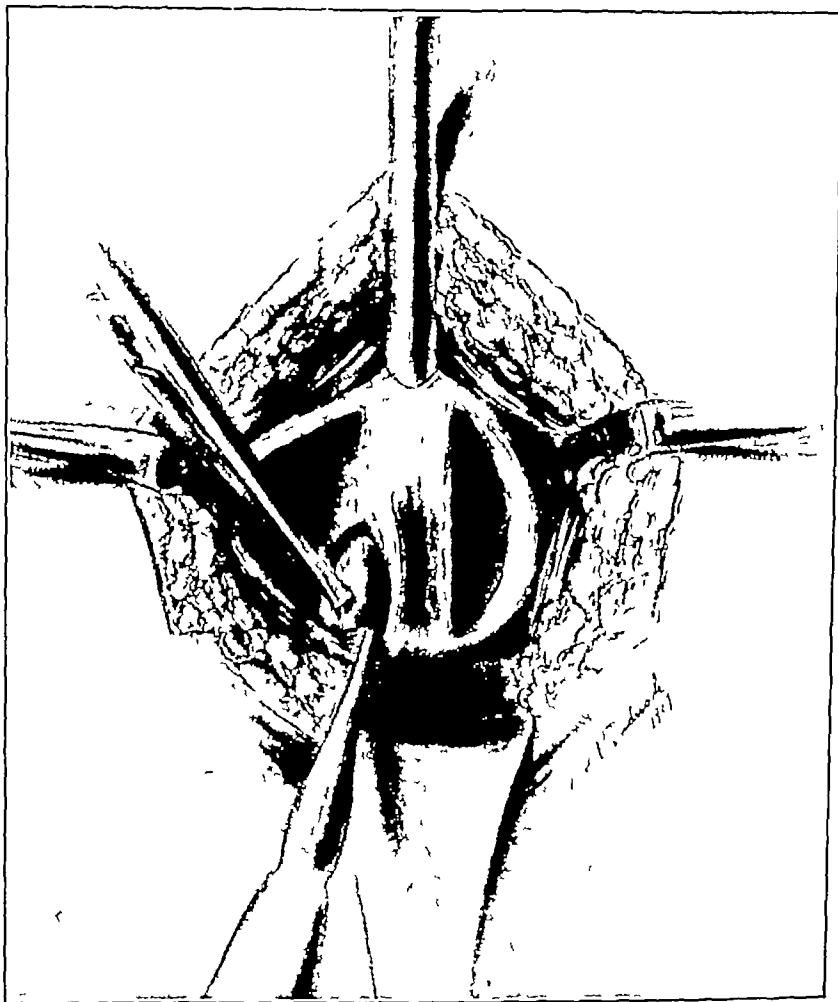


FIG 406 — Removal of fibrous median bar or lobe with a sharp curette

A careful examination is then made with the finger inside the vesical sphincter to determine the presence of any contracture or bar or remaining lobes at the prostatic orifice. Occasionally an anterior lobe or enlargement is found and can be easily removed through the urethra. Previous cystoscopy will have told of the presence of calculi, but they may have been obscured behind hypertrophied lobes, and on this account a careful search should be made at this stage of

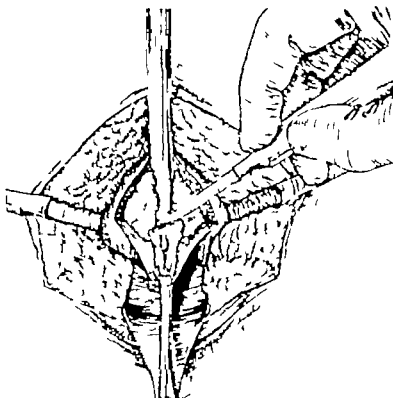


FIG. 409.—Inverted Y capsular incision. The urethra covering the median portion of the prostate lobe is incised transversely with scalpel previous to enucleation of median enlargement of prostate gland with the finger.

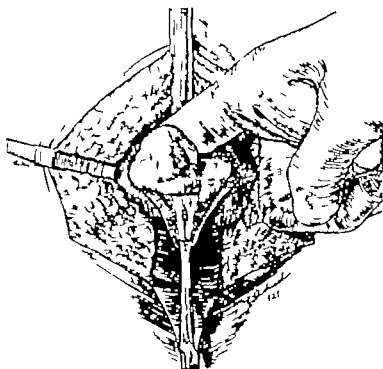


FIG. 410.—Completion of lateral enucleation with the finger.

torn on one or more sides and not infrequently partially removed with the hypertrophied lobes, and in some cases the bridge containing ejaculatory ducts had been torn from its anterior attachments in the vigorous traction necessary to remove the hypertrophied masses through the bilateral capsular incisions. This loss of prostatic urethra seemed to have very little influence upon the wound healing or ultimate results. It was also shown that in some instances considerable difficulty was experienced in enucleating completely all the hypertrophied lobes or lobules at the vesical neck, and occasionally hypertrophied tissue had been left behind which should have been removed.

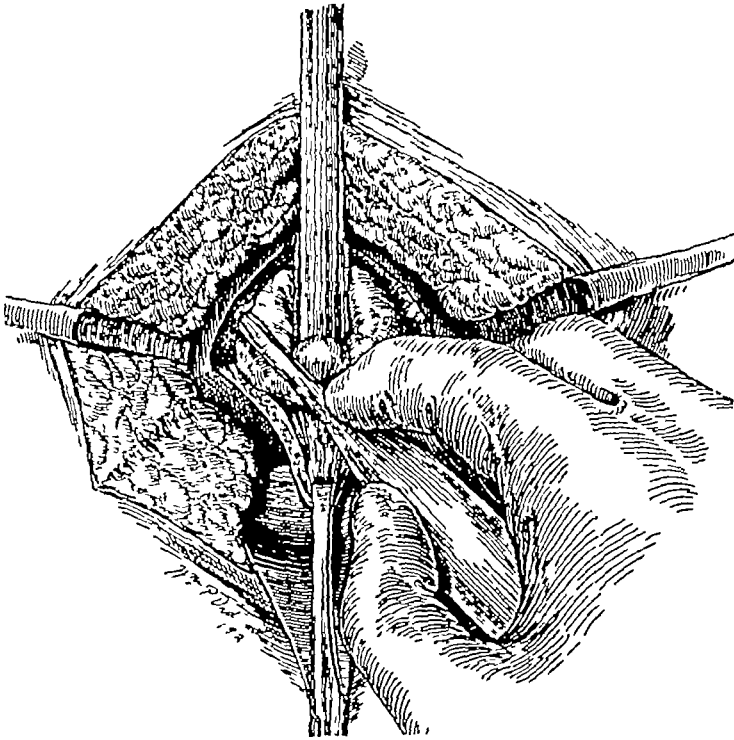


FIG. 408.—Inverted V capsular incision. Enucleation of lateral lobes begun with blunt dissector.

It was, therefore, decided to revert to the technique used in the very earliest cases and enucleate the entire hypertrophied prostate in one piece, being careful to preserve the verumontanum, ejaculatory ducts, but intentionally dividing the urethra on each side and in front of the median lobe in order to facilitate the enucleation of the prostate in one piece. This technique is shown in Figs 407 to 408. As seen here an inverted V or U capsular incision is made and the urethra opened. By this technique it is possible to obtain a better view of the deep portions of the hypertrophied mass and to remove it completely in one piece. A study of the results seems to show that cutting through lateral walls of the prostatic urethra on each side does no harm and the operation is undoubtedly made much more certain. The hyper-

trophied prostate can also be successfully enucleated through a single slightly lateral capsular and urethral incision as shown in Figs. 411 to 416. Here again the urethra is divided on each side and in front of the median lobe, the ejaculatory ducts being carefully pushed backward and the entire prostate being enucleated in one piece as shown in Fig. 415.



FIG. 413.—Enucleation of lateral lobes which was started with scalpel is complete with finger, the tractor being carried downward.

Not infrequently one finds hypertrophy of the subcervical group of glands which forms an entirely separate lobe internal to the vesical sphincter. It is therefore often advisable before completing the deep enucleation to remove the tractor and insert the finger through the sphincter into the bladder and draw it up so as to enucleate any superficial lobule which may be present with the aid of a curette (Fig. 416). The operator can usually see and push back the sphincteric fibers and enucleate the subcervical and middle lobes along with the rest of the prostate in one piece as in Fig. 417. As the hypertrophied lobes are drawn upward the mucosa which extends down from the bladder into the urethra can be separated with the finger, the inner aspect of the lobes leaving when the prostate is removed a fairly

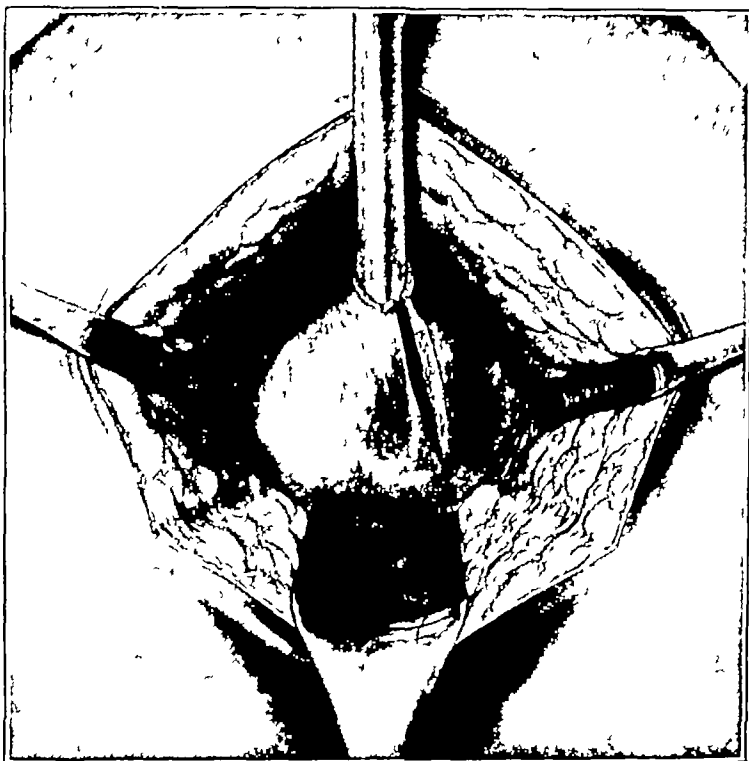


FIG 411 —Latest technique with single lateral capsular incision almost parallel to the urethra and just external to the verumontanum and ducts This incision opens upon the urethra along the left lateral wall

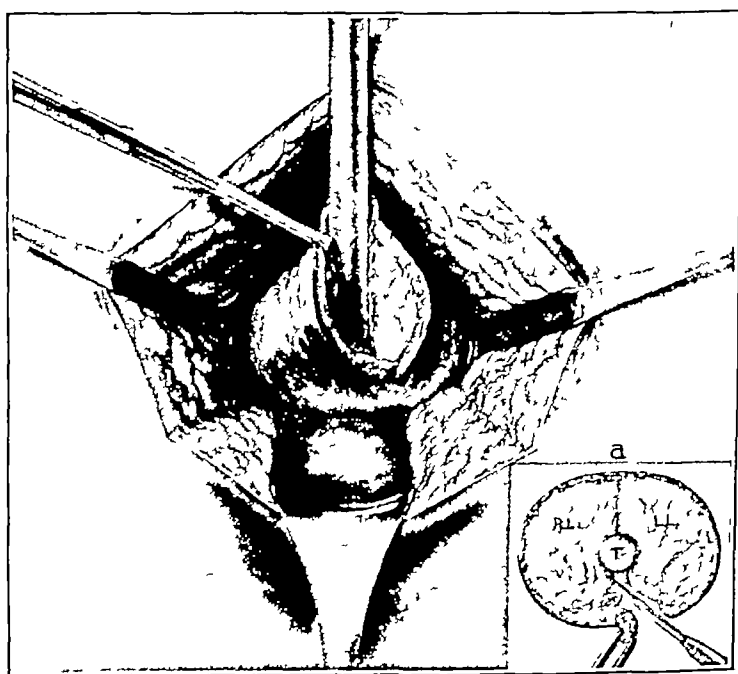


FIG 412 —The prostatic capsule has been opened by oblique lateral incision which extends into the urethra and divides the left lateral wall of the urethra to the middle lobe Enucleation of the left lateral lobe begun Mucous membrane covering the right lateral and median lobes divided as shown in subsequent drawings

long cone of mucous membrane in the lateral walls of which not infrequently one or more blood vessels can be seen clamped and ligated. Another advantage of preserving this cone of mucous membrane is that when the drainage tube is introduced a small pack can be placed within the vesical orifice thus retaining this cone of mucous membrane in its extravesimal position and efficiently stopping hemorrhage.

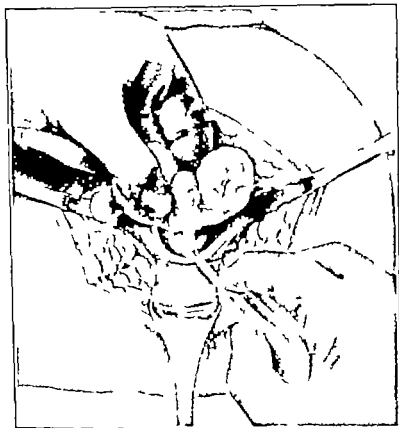


FIG. 416.—The tractor has been removed and the index finger of the left hand introduced through the vesical orifice into the bladder to investigate the median portion. The subtrigonal lobule has been discovered, and is being separated from the sphincter by the blunt tractor.

Another method of carrying out this total enucleation of the hypertrophied prostate in one piece through the perineum is to break through the mucous membrane of the urethra laterally on each side as in the intra urethral suprapubic method. By this technique the prostate can be enucleated with great facility, but more mucous membrane is removed and the cone of mucosa above described is usually not preserved and perhaps the hemorrhage is a little greater.

In some cases hypertrophied tissue may be present in the anterior commissure. It may be even an hypertrophied lobe which may be large enough to project considerably into the bladder. If such is made out with the cystoscope before operation the anterior commissure should usually be removed with the lateral lobes as shown in Fig. 418. In this way the specimen removed is almost identical with that which is

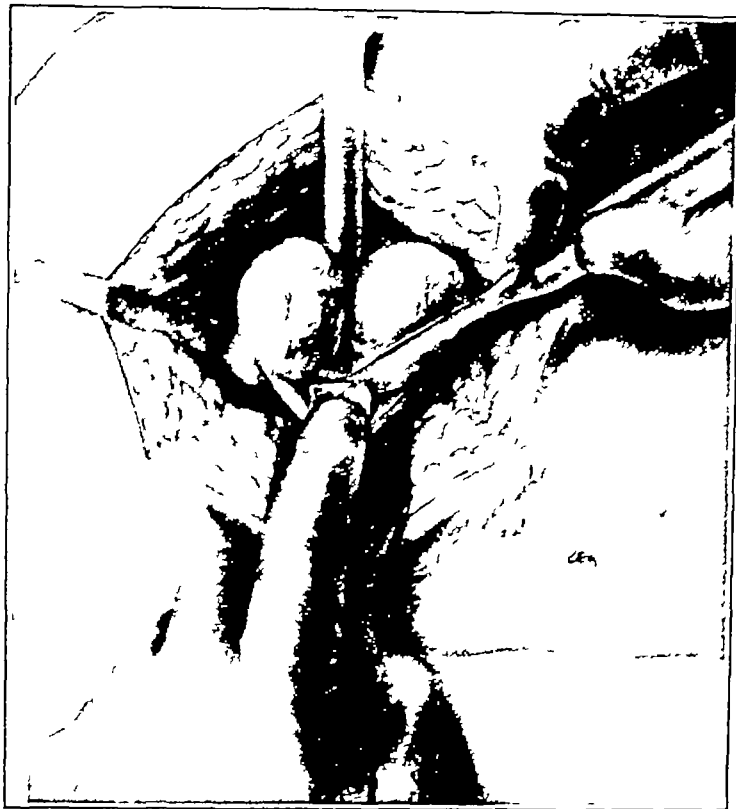


FIG 414 —With tractor held vertically, beak directed downward, the lateral lobes having been freed, the mucous membrane in front of the middle lobe is being divided transversely with scalpel. Ejaculatory ducts covered by index finger which pushes them backward.

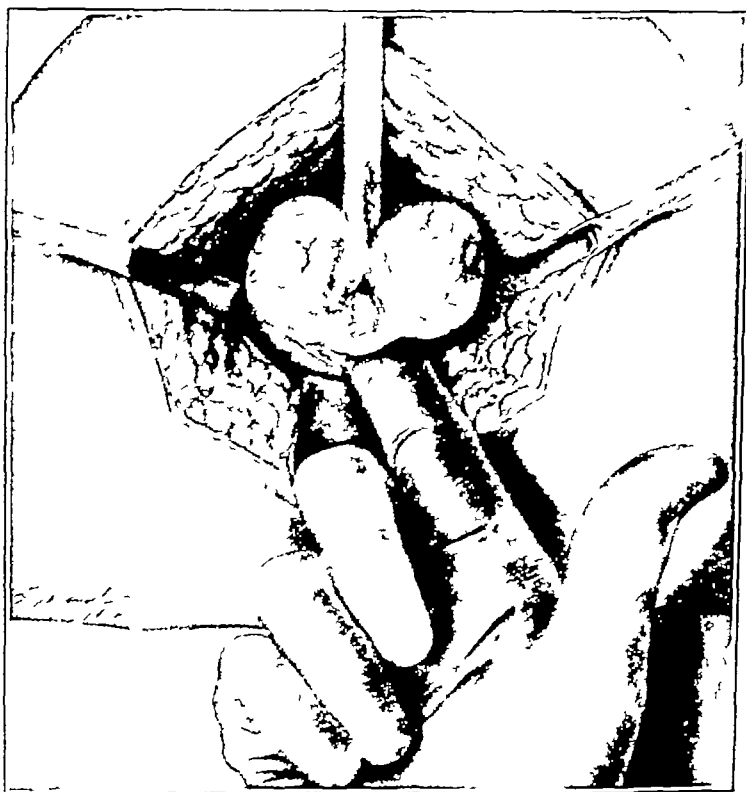


FIG 415 —The middle lobe attached to the two lateral lobes already freed is being separated from the sphincter and vesical mucosa and enucleated from behind forward.

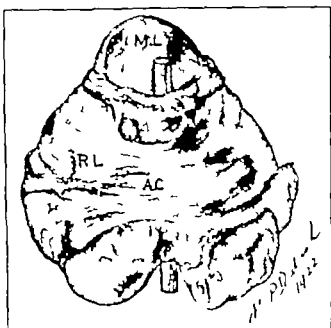


FIG. 419 — Anterior view of hypertrophied prostate removed *en bloc* with anterior commissure and a portion of the prostatic capsule. Glass tube shows site of urethra.

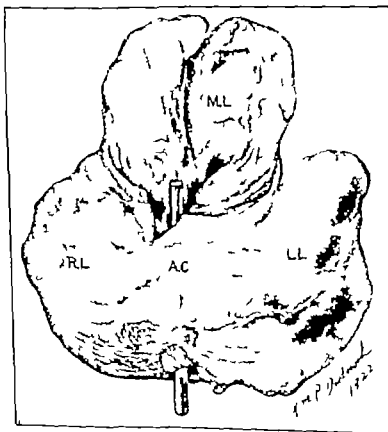


FIG. 420 — Anterior view of very large prostate removed *en bloc* with anterior commissure.

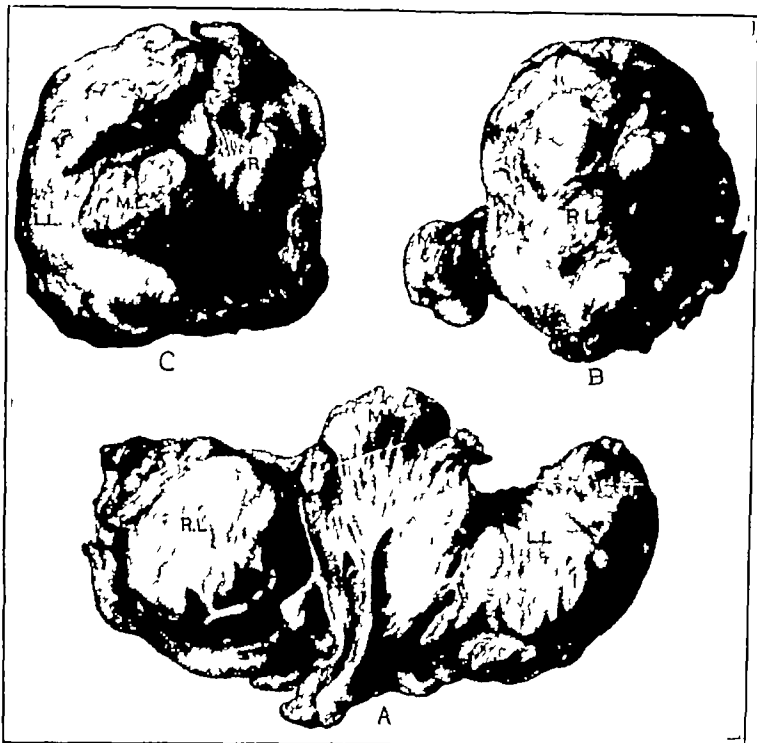


FIG 417 —A, anterior view of lateral and median lobes removed in one piece B, side view of right and median lobes of specimen Note the constriction of median lobe by sphincter and small subtrigonal posteriorly projecting lobule C, vesical aspect of prostate showing the small intravesical median and very large extravasical lateral lobes If this had been removed suprapubically the sphincter would surely have been destroyed

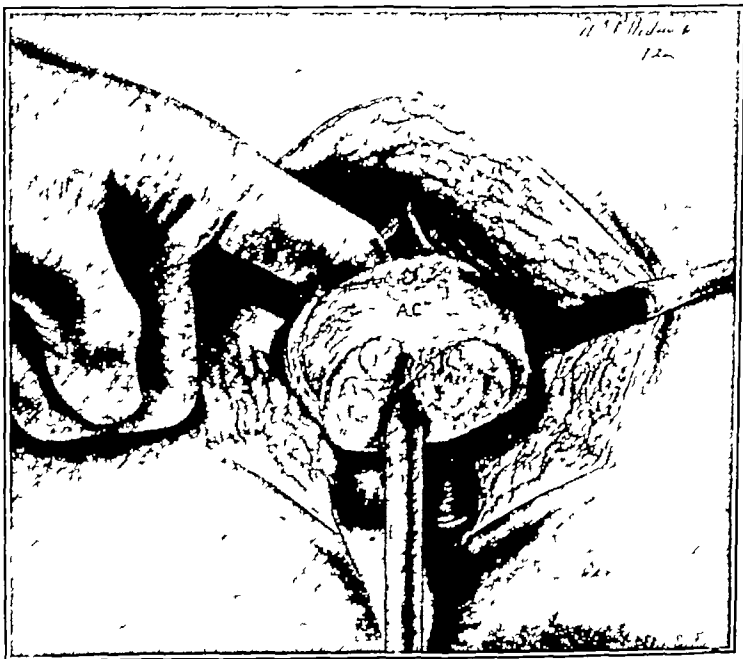


FIG 418 —Enucleation of prostate *en bloc*, with anterior commissure intact A C, anterior commissure

of operation has been fairly pronounced a saline infusion or transfusion should be carried out either during the operation or before leaving the table. This however is rarely necessary and the routine is to give submamillary saline infusion on the return to the ward. Gas-oxygen anesthesia was formerly preferred but pinal anesthesia with pantocain mg 10 is now employed in almost all cases. In both instances the patient on return to the ward can usually begin to drink water.

The subsequent treatment in perineal prostatectomy cases is to prop the patient up in bed as soon as convenient in order to facilitate drainage to remove the packs within twenty-four or forty-eight hours (a good scheme is to insert oil through a small catheter which has been placed among the packs at operation so as to facilitate their removal). If many packs have been introduced it is usually wise to remove them piecemeal in two or three steps several hours apart. Somewhat later often the following day the large perineal drainage tube is removed after which no further drainage either tube catheter or gauze is introduced. The wound is allowed to collapse as quickly as possible some mild antiseptic is injected generally through the open wound by the orderly when the dressings are changed but simply for cleanliness the patient is gotten out of bed on the third or fourth day and is encouraged to walk within a week if possible. The advantage of all this is that hypostatic congestion of the lungs is avoided the strength of the patient returns more rapidly and convalescence is facilitated.

In a careful study of 450 cases²² the time of closure of fistula was within one week in 18 cases two weeks in 73 cases three weeks in 130 cases—56 per cent in less than twenty-one days but in 15 per cent the fistula was present after the sixth week. In some of these protracted closures it may be advisable to pass a sound not on account of stricture which very rarely occurs but simply to straighten out the coapted surfaces of the membranous urethra. It is usually wise quite early in the convalescence to force fluid about 20 cc with a rubber bulb syringe through the meatus and out of the perineal wound to open up the membranous urethra and to facilitate the escape of urine through the anterior urethra. This should be repeated once every four or five days until urination is established. A sound should be passed through the membranous urethra and apex of the prostate (but no further) if there is delay in the urine coming through the anterior urethra. Stricture practically never occurs but in rare instances dilations have been necessary. Occasionally a retention urethral catheter is advisable to hasten the closure of the fistula as is sometimes the case after a suprapubic prostatectomy and of course curettage may be necessary to induce healing. In the 450 cases above mentioned however there are only 5 in which fistula persisted and 3 of these had received practically no treatment after discharge being pauper patients who did not return. Sixty-four per cent of the patients left the hospital within four weeks and only 3 patients had incontinence.

removed by the suprapubic technique of Freyer Figs 419 and 420 show hypertrophied prostates of this type removed through the penis

After the operator has satisfied himself by digital examination within the vesical sphincter that all hypertrophied tissue bars and contracture have been removed and the bladder has been searched for stone, the large drainage tube is introduced and beside it a small gauze pack is inserted within the vesical orifice as described above The lateral cavities are packed carefully, each with one or more strips of gauze and sufficiently tight to effectively stop the hemorrhage (Fig 421)

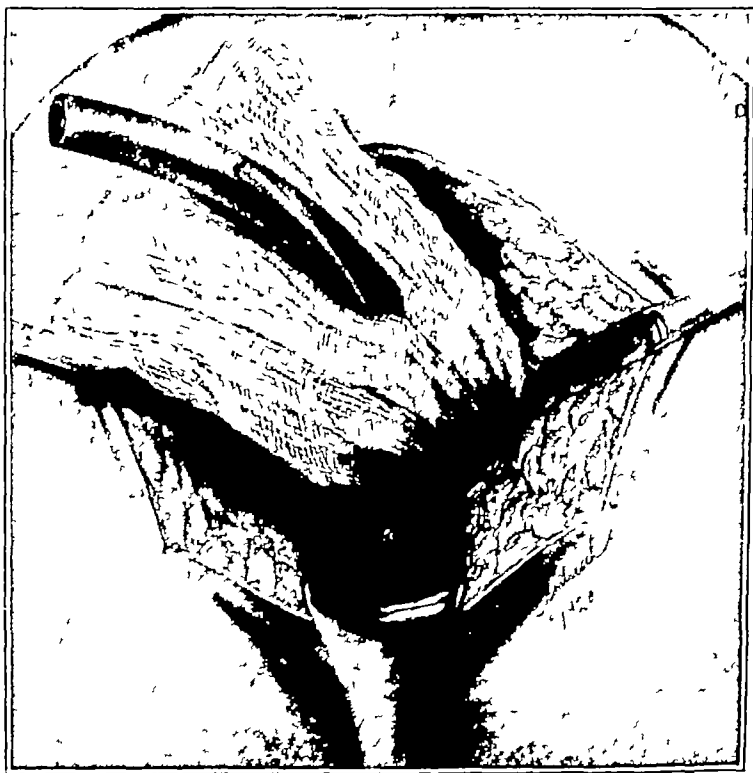


FIG 421 —Large tube has been inserted into bladder, a small tube into the cavity for the insertion of oil to facilitate removal of gauze which has been introduced into the lateral cavities to arrest hemorrhage

In some instances it may also be wise to place an additional gauze pack behind the prostate and before closing the skin wound the operator should be sure that the hemorrhage had almost completely ceased

It is well then to wash out the bladder by means of a large syringe with an orifice sufficiently great so that clots may be removed by suction The drainage tube is then fastened to the lower angle of the wound on the right side, the gauze packs are brought out in front of it and the apex and one angle of the wound closed up either with chromicized catgut sutures or metal clamps, leaving about two-thirds of the wound open on one side for drainage and packs

If the patient is a feeble individual or the hemorrhage or shock

outcome in the hands of experts. Age is not a contraindication but the length of time of the obstruction and the kidney function determine the operative risk. There is no other class of cases in which careful attention by the surgeon before and after the operation plays such an important part.

The preoperative technique now employed by us is practically identical with that described above. We still have great confidence in the phenolsulphonephthalein test as the safest indicator of renal impairment. When supplemented by blood-uric acid determinations an accurate picture of the condition of the kidneys is usually presented. The administration of fluids in considerable quantity before and after operation and appropriate cardiovascular therapy in cases requiring it are routine procedures. An effort is made to get the patient in an optimum condition before performing operation.

The technique of the perineal operation employed is usually identical with that cited above. The bilateral capsular technique is sometimes employed particularly in younger men but the inverted V technique with enucleation of the lateral median and sometimes anterior lobes in one piece is more commonly used. Instead of packing the vesical neck and prostatic cavity with gauze or employing the Davis hemostatic rubber bag we usually introduce sutures through the vesical neck and out through the remaining prostatic tissue laterally and posteriorly. In this way hemorrhage is arrested, packing avoided and obliteration of the cavities accomplished. In a good many cases a suture is placed through the tissue around the ejaculatory ducts so as to ligate spermatic ducts there instead of in the groin. This has apparently been quite effective in arresting epididymitis.

The recent interest aroused in the early diagnosis of carcinoma of the prostate which has been shown by the papers of Rich and of Moore to be so very common has led to the early operation upon suspicious cases, in some of which the pathology was found to be non-malignant, but in an important number of cases carcinoma was discovered at an early stage and radical operation successfully performed.

In the postoperative care of patients subjected to perineal prostatectomy we have recently been more prone to employ an indwelling urethral catheter for at least a week and during this time make daily injections of mild antiseptics such as 0.5 per cent mercurochrome or argyrol. As a result, it has rarely been necessary to pass sounds after operation and we have seen very few cases of markedly delayed closure of the wound. Should the patient be intolerant to the catheter or suppuration occur around it much earlier removal is usually indicated.

A recent study of our statistics in regard to immediate and ultimate results and mortality discloses approximately the same figures as we have previously published with certain variations from time to time. We have not had recently the good fortune as we did several years ago of having no deaths in 108 consecutive cases. The benignity

which however, was not complete but only during the day and not at night

The most important therapy after the operation is to force water, by mouth if the patient can take it, and if not by infusion, or by transfusion if necessary. In this way severe uremia and often also infections of the bladder and kidneys can be washed away. Some patients take 10 quarts a day without much difficulty.

The preservation of sexual powers after operation is important and is more or less definitely connected with the careful protection of the verumontanum, ejaculatory ducts and floor of the urethra. In the 450 cases above mentioned in all patients under sixty years of age erections returned after operation. Sexual impairment was apparent only among these over sixty years of age, 74 per cent state that coitus is still indulged in, where it was possible before operation.

Among the 450 cases there was a mortality of 37 per cent but since 1910 there has been a gradual improvement and in a recent paper 166 consecutive cases of perineal prostatectomy by the technique above described without a death were reported, and in a more recent paper the list of 198 consecutive successful cases without fatality has been reported by Young. These figures are quoted to show the fact that prostatectomy has become a really benign operation when proper care in diagnosis, preoperative and postoperative treatment is given, and careful attention during the operation is taken to the control of hemorrhage. Among these 202 cases there were 5 patients over eighty, and 59 over seventy years of age. Thirty per cent of the cases required preliminary preparatory treatment for ten days or more, and 2 had suprapubic drainage.

Recently interesting papers upon Young's perineal prostatectomy with some personal modifications have been published by Hinman, Cecil, Crowell and Geraghty. All of these papers lay stress upon the simplification of the convalescence and the low mortality of perineal prostatectomy. The papers by Cecil and Geraghty lay stress on the importance of preserving the external sphincter by the use of long urethral tractors, such as Young has used for several years in cases of excision of tuberculosis of the prostate and seminal vesicles without opening the membranous urethra.

Geraghty, and Cecil a short time afterward, independently of each other brought out a modification of Young's operation. They felt that the exposure of the prostate by their technique simplifies rather than complicates the dissection. The method proposed differs essentially from the technique described by Young for hypertrophy in that the membranous urethra is avoided. Its intrinsic and extrinsic musculature as well as the nerve supply are neither disturbed or injured.

Prostatic surgery has outgrown the experimental stage. The methods of preparation and the operative procedure are on a sound basis. The choice of operation is one of personal preference of the surgeon. There is little difference in the mortality rate or the final

CHAPTER XVIII

SECTION II

SUPRAPUBIC PROSTATECTOMY

By J. BENTLEY SQUIER, M.D., F.A.C.S.

IN the previous edition of *Modern Urology* the subject of prostatic obstruction was ably written by the late Dr James A. Gardner and one of his paragraphs so well summed up the question of the choice of methods for relieving the obstruction that I quote it verbatim.

It is of interest to note in surveying the literature of the subject that among the many different methods of attacking the prostate that have been proposed by different surgeons practically equally good results are reported to have been secured by the most diverse methods by men who have become specially skilled in their application. It cannot be however that the choice of method is a matter of indifference a question of chance or prejudice. In view of the frequency of the malady the general recognition of the possibilities of operative relief will prompt the surgeon to supply it. So the question is no longer what is possible in the hands of an expert but what, in the light of our present knowledge of the anatomical relations and the pathological changes of the prostate gland will in the hands of the average surgeon most certainly and safely wholly and permanently relieve the obstructive dysuria that the prostatic disease has produced.

This to me is the crux of the situation for many surgeons lacking opportunity for the more technical urological training of those men who have devoted themselves exclusively to urological surgery will easily appreciate the fundamental soundness of the surgical principles which underlie suprapubic prostatic removal and for this reason will find such an approach more within their surgical capabilities. This is not a reflection upon other methods of prostatic removal. They have a place although in my judgment a more restricted one and it is only a surgeon who has had wide experience in all methods who can properly evaluate the indications for their special employment.

The story of the development of prostatic surgery is an engrossing one. Two thousand years ago Celsus made a perineal approach to the bladder and nearly five hundred years ago Johannes de Romanes designed an instrument similar to the staff used today upon which the deep urethra is opened.

Attempts instrumentally to remove obstructing portions of the prostate were carried out by Mercier in 1837 a tunnelling type of operation the forerunner of the cold punch of today. In 1873 Bottini

of the operation is conclusively demonstrated by the fact that during 1934-1935 Dr Walter W Baker, the Resident Urologist at the Brady Urological Institute, had 58 consecutive perineal prostatectomies on the public wards without a single death. Among the 3500 cases of perineal prostatectomy operated upon by visiting and resident urologists, the mortality remains about 3.5 per cent. When one considers that about 50 per cent of these patients have some form of cardiovascular disease, that a large proportion are admitted with impaired renal function, severe infection, and often pronounced poor operative risks, the safety of perineal prostatectomy is abundantly shown.

We shall not attempt to draw any conclusions here as to the choice of operation, inasmuch as we are not discussing the subjects of transurethral resection or suprapubic prostatectomy, both of which have an important place in the surgical therapy of prostatic obstruction. Perhaps we may be permitted to say we are still of the opinion that on account of its simplicity, low mortality, excellent results, in addition to the chance it affords to make an early diagnosis of carcinoma and obtain a radical cure, perineal prostatectomy ranks as the most important procedure for handling pronounced enlargements of the prostate.

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began to experiment with his galvano-cautery knife, an instrument to divide prostatic obstructions, trying to accomplish by sense of touch what the modern cystoscopic resectionist makes possible under vision. This method, a poor one at best, flourished for over twenty-five years. Although our present-day suprapubic prostatic surgery dates back to the work of Belfield of Chicago and McGill of Leeds, during the eighties of the last century, there had been removals of portions of the prostate by the suprapubic route as far back as 1836, when Amussat¹ removed a middle lobe with scissors. Billroth and Dittel in 1885, and Benno Schmidt and Trendelenburg in 1886, had performed similar operations.² The work of Belfield and McGill caused great comment at that time among the surgeons of America, England and France and many were stimulated to follow their teachings. However, many of the end-results were disappointing, because by removing only prostatic outgrowths, in over 30 per cent of their cases they had failed to restore voluntary micturition. Their explanation for this they termed permanent atrophy of an overstretched bladder, they failed to appreciate that complete removal of all the hypertrophied prostatic tissue would have insured against many of these failures, although Belfield³ did in a way sense it, for in one of his reports he stated that "the intravesical projection may in a given case constitute but a part of the prostatic obstruction." It remained for Eugene Fuller⁴ of New York, in 1895, to perform the first complete suprapubic removal of the prostate. He claimed that the failure of partial prostatectomy to restore micturition in many instances was due to the obstruction still present from the unremoved portions of the gland, his statement being "if however, all the hypertrophies, median, lateral and round about the prostatic urethra are removed the results, as far as the bladder is concerned are, barring mortality, satisfactory."

Sir John Thomson-Walker in his Lettsomian Lectures of 1930, paid a high tribute to this statement of Fuller's in commenting upon it as follows: "This was a very important step in the attack on the enlarged prostate by the suprapubic route, but little, if any, attention was paid to it, so strongly did the idea of White hold the attention of the surgical world. Here for the first time was laid down that the routine operation of suprapubic prostatectomy must include the 'hypertrophies' along the prostatic urethra in other words, the extra-vesical or rectal enlargement as well as the intravesical projection."

Sir John was referring to Dr J. William White of Philadelphia who, two years previous to Fuller's report, namely in 1893, had suggested castration for the relief of prostatic obstruction. His argument was that there was a possible analogy between uterine fibroids and prostatic hypertrophy, that as shrinkage of fibroids takes place following oophorectomy, a similar reduction in the size of prostatic hypertrophies might take place following castration. White had read a paper before

¹ Amussat *Memoire presente a l'Institut Paris*, 1836

² Thomson-Walker, Sir John *Lancet*, May, 31, 1931

³ Belfield, W. T. *Am Jour Med Sci*, November, 1890

⁴ Fuller *Jour Cutan and Genito-urinary Disease*, p. 23, 1895

the American Surgical Association and although suggesting such an operative procedure made the statement that as yet he had not seriously recommended the operation. Dr White's novel theory took the surgical profession by storm. In 1893 Mears suggested the less formidable operation of vasectomy as against castration to produce regression of the prostate even though as early as 1825 Sir Astley Cooper had proven that vasectomy had absolutely no effect upon reducing prostatic enlargement.

I have mentioned the subject of castration and vasectomy because the influence of Dr J. William White on the surgical thought of the day was so strong that many surgeons of the nineties desisted from operating upon obstructive prostates because of his fallacious deductions. It remained then for Mr P. J. Freyer in 1901 to again stimulate interest in suprapubic prostatic removal. He published 4 cases in which total extirpation of the prostate had been performed and the operation that he recommended consisted in removing the entire prostate with its capsule, the line of separation lying between the capsule and the rectovesical sheath, the capsule being removed and the sheath remaining behind. [This remarkable statement which Freyer made in substantially similar form on many occasions is of course quite without basis in anatomical fact. The operation which he did and which was technically similar to that of Fuller sought to enucleate the masses of fibroadenomatous hyperplasia from within the prostate. The capsule to which Freyer referred was of course not the true capsule of the prostate but what had for many years at least in this country been known as the surgical capsule of the prostate. This consists of compressed prostatic tissue flattened by the growing masses of fibroadenomatous hyperplasia. The cases in which he claimed that he removed the whole prostate were cases in which the lateral lobes and the commissural portion were removed in one piece as can always be done when the enlargement is of this type. Had the operation really removed the prostate with its true capsule it would have required sharp dissection and would have involved very serious bleeding.—F. DITTO.]

Following the renaissance given to suprapubic prostatic surgery by the publications of Freyer his methods were rapidly embraced by surgeons in all countries. The suprapubic prostatectomy of today is in reality but a refinement in technique of its Fuller and Freyer prototype, but these refinements have been the result of the combined thoughts of many surgeons and so important have these been that many of the dangers incident to operation upon the prostate have been minimized or eliminated.

Today there are three major surgical methods in vogue for the relief of prostatic obstructions namely suprapubic prostatectomy, perineal prostatectomy and transurethral resection of portions of the obstructing prostate, either by punch or cautery loop.

These three methods are discussed separately in this edition of *Modern Urology* by surgeons who have had unusual experience with

the methods they describe, and to that most important period in the management of a patient suffering from urinary obstruction due to prostatic hyperplasia, namely, the period of preparation for operation, another section is devoted. In regard to operative work upon the prostate gland Hinman has well observed, "Operation has become an incident in the course of management of which preparation is the substance."

Of all the methods employed for the relief of prostatic obstruction there is none which produces a short cut to rapid cure. However, by keeping in mind the knowledge we have of embryology, anatomy, physiology and pathology of the prostate we may obtain the first prerequisite, a proper diagnosis of the type of obstructing lesion, or further, a clear understanding as to how, and why and in what manner the prostatic obstruction with its sequelæ exists and manifests itself.

Having accomplished this, the most logical operative procedure to undertake should suggest itself more easily according to the individual experience and endowments of the surgeon.

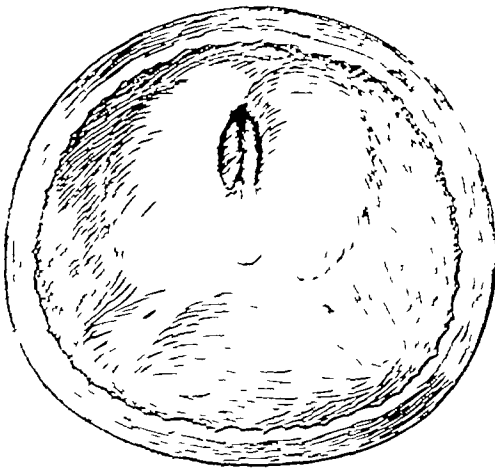


FIG. 422.—Appearance of bladder neck in lateral lobe hypertrophy. The sphincter surrounds the orifice with the prostatic mucosa of the lateral lobes visible.

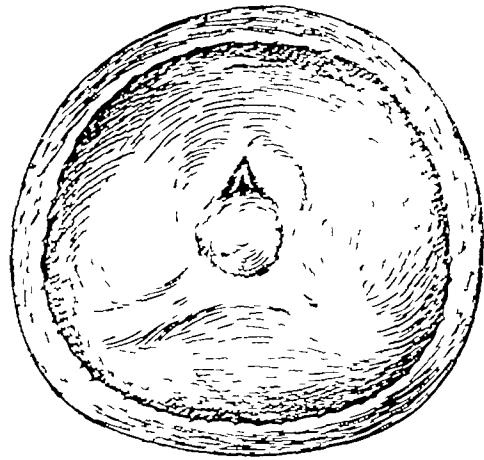


FIG. 423.—Appearance of bladder neck in middle lobe hypertrophy. The sphincter surrounds the middle lobe which is covered with prostatic mucosa and has projected through the sphincter into the bladder.

The merits of suprapubic prostatectomy which make for the ranking position it holds in operative choice may be stated in a few sentences. It is an operation that produces the most satisfactory restoration of urinary function which has become impaired by obstructing prostatic hyperplasia. This is the same however the obstructive lesion is manifest whether as lateral lobe hypertrophy (Fig. 422), median lobe hypertrophy (Fig. 423), or a combination of both. Suprapubic approach is also the most satisfactory route for managing associated vesical pathological conditions which are so often associated with urinary obstruction, namely calculi, diverticula or neoplasm. Other merits could be mentioned; the above however are undebatable.

THE OPERATION OF SUPRAPUBIC PROSTATECTOMY

Position and Preparation.—The patient is arranged flat upon his back upon the operating table in the most comfortable position. Adjustments are made with padded shoulder supports and a proper bend in the table so that the knees may be flexed and the table tilted in Trendelenburg position. Undue pressure upon any part should be avoided especially in aged subjects.

Distention of Bladder—In obese patients or those in whom the pelvis is very deep it is expedient to distend the bladder before operation so that when it is exposed it may be easily identified. In thin patients this is not necessary. Various media are used. Air in spite of fears of emboli if carefully introduced has but little danger. The fact that air may be forced out of the bladder through the urethra without being recognized is rather against its routine employment. The solution most easily tolerated is 2 per cent boric acid. A catheter is introduced through the urethra, and the bladder emptied. The bladder is then irrigated and 200 cc. of the solution is left within it. When the catheter is withdrawn it may be necessary to compress the penile urethra with some mechanical clip to prevent the patient urinating part of the solution during the early stage of anesthesia.

Anesthesia.—There is no one best method of anesthesia for all patients suffering from prostatic obstruction. Many factors will influence the choice of method—the temperament of the individual his general physical condition the condition of his heart and blood vessels etc. The choice of anesthetist is as important as the choice of the type of anesthesia to be used and the operating surgeon must needs use the method with which he and his operating staff are most familiar.

I believe that as the majority of prostatic operations are upon patients who are debilitated and at an advanced period of life that expedition in operating and a minimum of anesthesia if general anesthesia is used are important considerations.

If spinal anesthesia is used the blood-pressure of the patient should be most carefully watched in order to be prepared for any sudden or considerable fall. A low spinal anesthesia produces a relaxation in the abdominal muscles which makes it a very attractive method from an operative standpoint.

If general anesthesia is used whether gas and oxygen gas oxygen and ether ethylene or cyclo-propane it is wise to have all preliminary measures such as bladder distention sterilization of the skin and draping of the patient carried out before the anesthesia is commenced so that as soon as anesthesia is produced the surgeon may commence operating.

Incision.—The classical incision is a midline vertical one beginning at the pubes and extending to just below the umbilicus (Fig. 424) varying in length with the amount of adipose tissue present (Fig. 425) and also with the pubo-umbilical distance. The usual incision is made 4 or 5 inches in length. Transverse incisions are recommended by

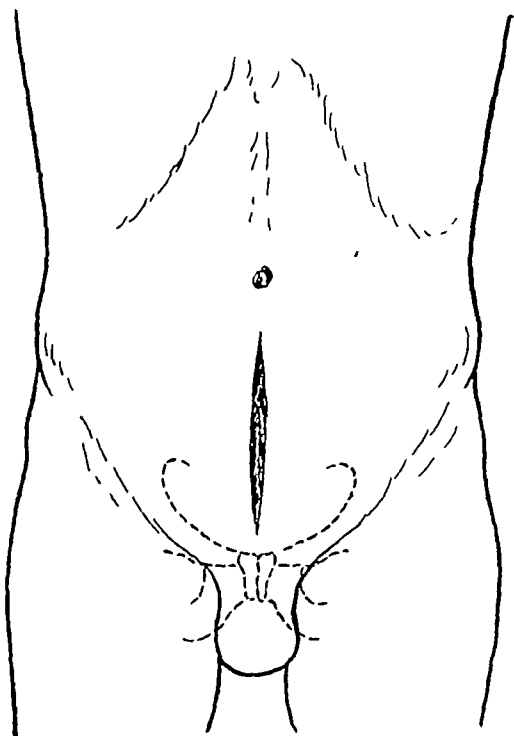


FIG 424 —The normal vertical suprapubic incision

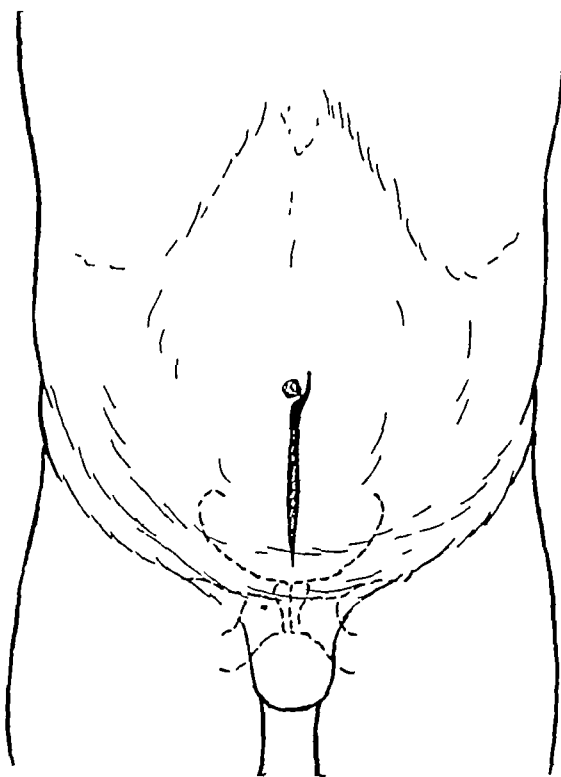


FIG 425 —Vertical incision necessary at times in obese individuals

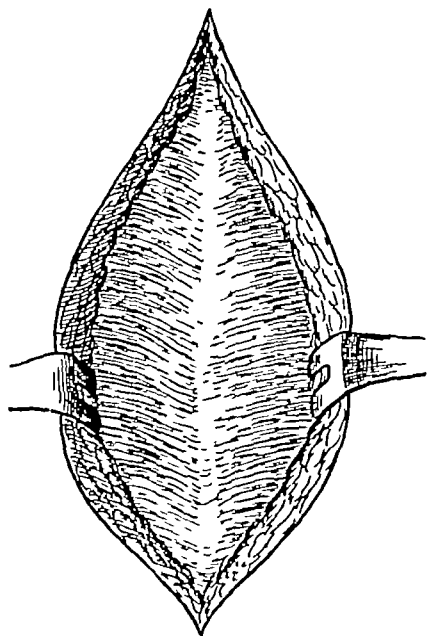


FIG 426 —The skin and fascia have been retracted, the aponeurosis of the recti is shown with the median raphe

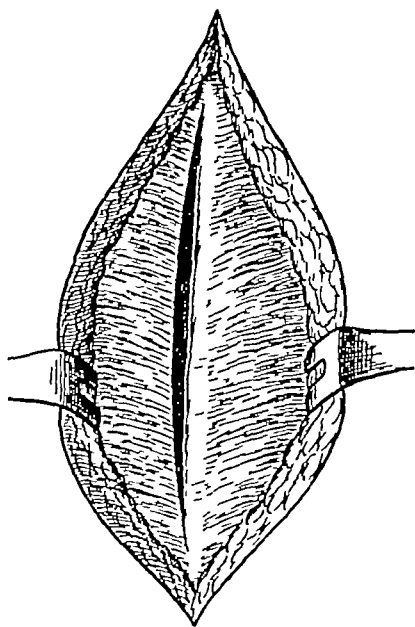


FIG 427 —A vertical incision is made in the aponeurosis of the right rectus

some authors especially in patients with obese abdomens. Various arguments have been advanced for their use but they give little or no advantage over the vertical incision. The incision is deepened through

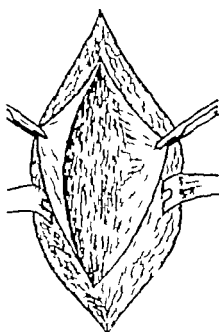


FIG. 428.—The aponeurosis of the rectus is retracted. The rectus muscle is separated from the median side where it is closely attached to the median raphe.

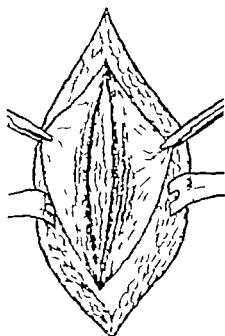


FIG. 429.—Both recti muscles are exposed by division of the median raphe.

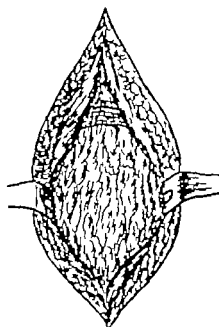


FIG. 430.—The recti muscles are retracted, showing the peritoneal fascia and the edge of the semi-lunar fold of Douglas above.

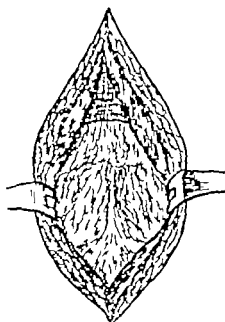


FIG. 431.—A thin subject with the converging fibers of the urachus attachment showing through the transversalis fascia.

the cellular tissues to the aponeurosis of the recti muscles (Fig 426) The aponeurosis is then opened vertically through one or the other of the recti muscle sheaths (Fig 427) The muscle is more firmly attached to the midline section of the sheath than it is to the outer edge and, using this as a guide, the muscle is separated from the median raphe (Figs 428 and 429) In stout abdomens such separation may have already occurred by long existent abdominal distention and detachment is found to be already existing The pyramidalis running obliquely across the lower part of the sheath is divided from above its attachment to the rectus near the pubis The recti muscles are retracted exposing the transversalis fascia (Figs 430 and 431) The trans-

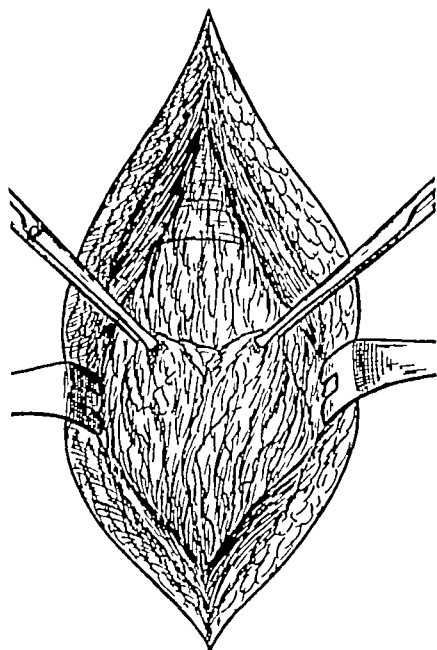


FIG 432—The transversalis fascia has been separated and the reflection of the peritoneum and urachus fascia peeled up The bladder is identified and grasped with traction forceps

versalis fascia is opened and separated laterally, exposing the perivesical fascia The bladder is identified by the dilated veins on its outer surface, by the peculiar granular fat, by the red muscle showing through the adventitious fascia and, if distended, by its ovoid contour The bladder is grasped with traction clamps (Fig 432) and the fascia at the vertex of the bladder stripped back to the peritoneal attachment Rarely the peritoneum may extend quite low anteriorly, and if so, it may be necessary to strip the peritoneum from the vertex to insure exposure At times a persistence of the urachus may make this more difficult In cases of long standing obstruction with infection there may be considerable inflammatory thickening of the perivesical planes and, when such a condition obtains, great care should be taken in their separation

After the bladder is exposed the wound is walled off with sterile pads An area on the anterior surface of the bladder is selected, preferably one free from blood-vessels This area is caught with traction forceps, the bladder opened with a scalpel, and an aspiration tube immediately introduced into the bladder to prevent any spilling of bladder contents into the perivesical space (Fig 433) When the bladder has been completely emptied by aspiration the edges of the incision are caught by forceps and the bladder incision enlarged (Fig 434) This incision is usually made vertically and, as a rule, gives adequate exposure with less injury to the blood-vessels of the bladder wall than if made transversely Rarely, either because of a short pubic space or on account of unusual arrangement of the bladder vessels, a transverse incision may be indicated

Bladder Examination.—The bladder having been opened and emptied of fluid the interior should be examined digitally and visually. By digital examination the mobility of the bladder its fixation and its structural density may be determined as well as that of the prostate and prostatic urethra. The finger may detect small calculi which resting in deep trabeculations, might be unrecognized by visual examination. Visual examination is obtained with suitable bladder wound retraction and illumination. Associated pathology which may exist is searched for at such inspection: the resulting changes in the bladder mucous membrane following obstruction such as trabeculation, cellulæ or diverticula, the presence of foreign bodies, calculi or tumors, etc. Urachal infections if present are recognized and very rarely inter-

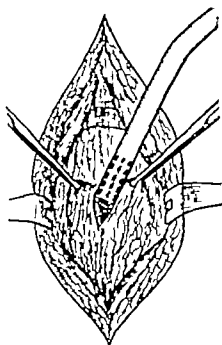


FIG. 433.—The bladder has been opened on the anterior surface with a scalpel and the aspiration tube inserted.

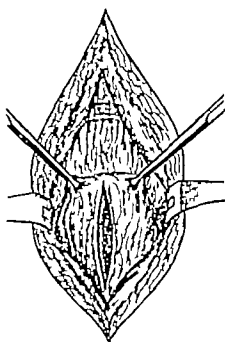


FIG. 434.—The bladder has been emptied. The incision is enlarged downward.

tinal fistulæ. Therefore a thorough visual inspection of the bladder and the prostate is most essential.

Prostatic Removal.—The prostate may be removed in three ways: (1) By finger enucleation without visualization at the time of removal; (2) by digital removal with visualization; (3) under visualization by dissection.

Digital Enucleation.—Digital enucleation of the prostate is best done without retractors in the bladder. In the procedure the operator should strive against producing an undue amount of trauma. The enucleation is done with the fore-finger in the prostatic urethra and the middle finger in the bladder and the remainder of the hand deep in the wound in the elastic perivesical space.

In obese patients and especially those with a very deep pelvis and with large lateral lobe prostatic hyperplasias, it may be inexpedient to remove the prostate except by digital enucleation. A careful palpation is made of the encroachment into the urethra and the enucleation is begun in that portion of the urethra where the prostate can be felt

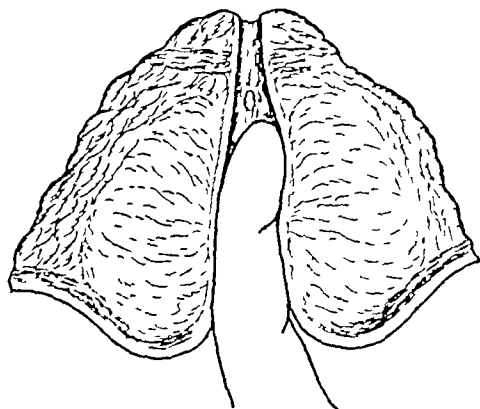


FIG 435 —Palpation of the index finger of the anterior portion of the right lateral lobe before starting the separation from the urethra

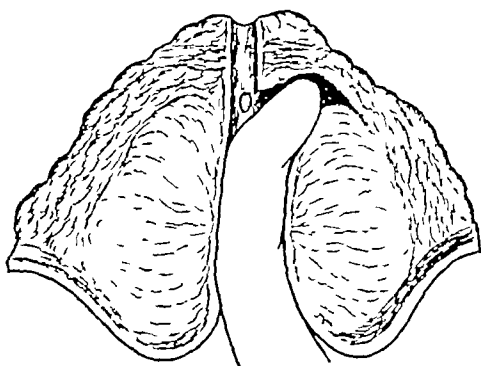


FIG 436 —The separation of the right lateral lobe from the antero-lateral part of the capsule

antero-laterally near the apex close to the external sphincter (Fig 435). The prostatic urethra is opened at this point (Fig 436). When the prostatic urethra is tightly contracted, the separation may be started only after the anterior commissure gives way and breaks over the finger. In either case the anterior and lateral portions of the

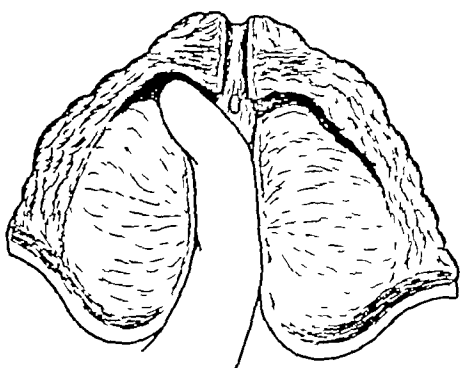


FIG 437 —The separation of the left lateral lobe from the antero-lateral part of the capsule

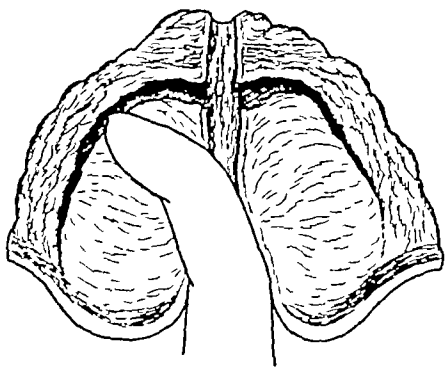


FIG 438 —The separation of the left lateral lobe from the anterior part of the capsule

lateral lobe, either right or left, which ever is the more prominent, are separated out from the prostatic capsule laterally, anteriorly and inferiorly (Figs 437 to 442) and finally, the separation is made freeing it from the internal sphincter. A similar procedure is carried out upon the opposing lateral lobe. At this point either one or both lateral

lobes may be delivered back into the bladder through the dilated but undamaged internal sphincter. They may then be released from their loose attachment to the floor of the prostatic urethra near the median lobe and removed separately. The median lobe if present may

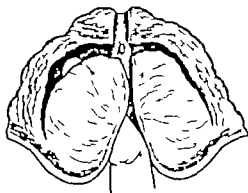


FIG. 439 — The separation of the left lateral lobe from the posterior part of the capsule

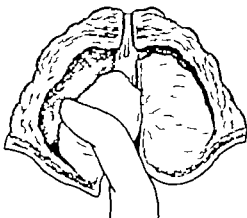


FIG. 440 — Separation of the left lateral lobe from the prostatic bed

be then separated off its attachment to the floor of the internal sphincter and trigonal muscle by the line of cleavage that has been developed (Figs. 441 to 446). This is then free of all attachments except to the prostatic urethra. This may be broken across anterior to the median lobe and behind the veru or it may be visualized and cut across well

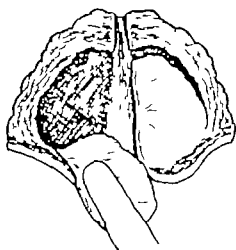


FIG. 441 — Delivery of the left lateral lobe through the internal sphincter

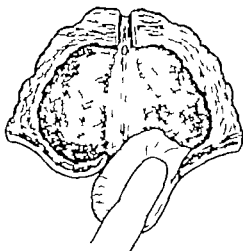


FIG. 442 — Delivery of the right lateral lobe through the sphincter

in front of the palpable median lobe. In some cases the attachment of the lateral lobes free but still attached to the prostatic urethra, the median lobe is peeled off the internal sphincter and the three lobes delivered into the bladder through the sphincter. The attachment of

In obese patients and especially those with a very deep pelvis and with large lateral lobe prostatic hyperplasias, it may be inexpedient to remove the prostate except by digital enucleation. A careful palpation is made of the encroachment into the urethra and the enucleation is begun in that portion of the urethra where the prostate can be felt

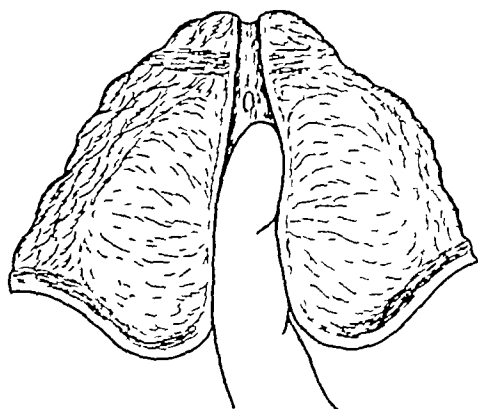


FIG 435 — Palpation of the index finger of the anterior portion of the right lateral lobe before starting the separation from the urethra

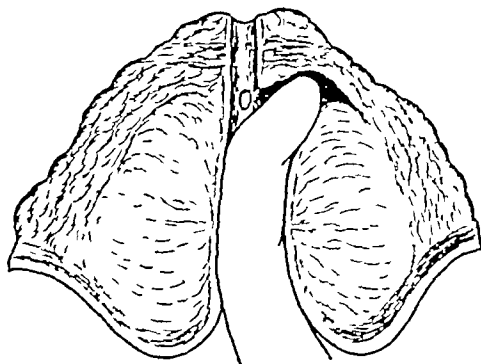


FIG 436 — The separation of the right lateral lobe from the antero-lateral part of the capsule

antero-laterally near the apex close to the external sphincter (Fig 435). The prostatic urethra is opened at this point (Fig 436). When the prostatic urethra is tightly contracted, the separation may be started only after the anterior commissure gives way and breaks over the finger. In either case the anterior and lateral portions of the

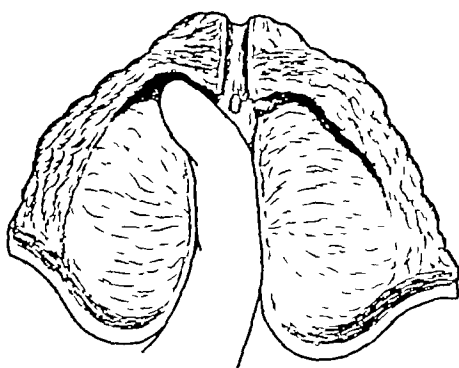


FIG 437 — The separation of the left lateral lobe from the antero-lateral part of the capsule

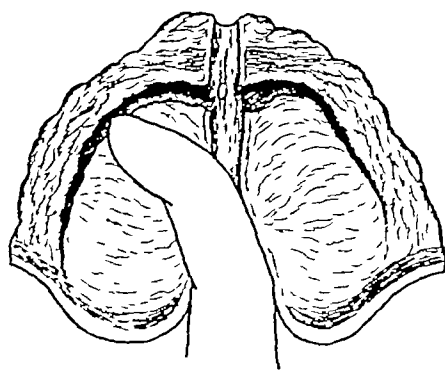


FIG 438 — The separation of the left lateral lobe from the anterior part of the capsule

lateral lobe, either right or left, which ever is the more prominent, are separated out from the prostatic capsule laterally, anteriorly and inferiorly (Figs 437 to 442) and finally, the separation is made freeing it from the internal sphincter. A similar procedure is carried out upon the opposing lateral lobe. At this point either one or both lateral

lobes may be delivered back into the bladder through the dilated but undamaged internal sphincter. They may then be released from their loose attachment to the floor of the prostatic urethra near the median lobe and removed separately. The median lobe if present may

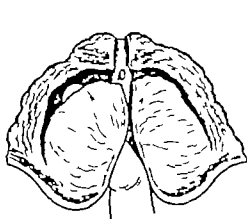


FIG. 439—The separation of the left lateral lobe from the posterior part of the capsule

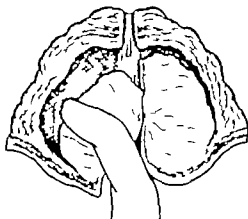


FIG. 440—Separation of the left lateral lobe from the prostatic bed

be then separated off its attachment to the floor of the internal sphincter and trigonal muscle by the line of cleavage that has been developed (Figs. 444 to 446). This is then free of all attachments except to the prostatic urethra. This may be broken across anterior to the median lobe and behind the veru or it may be visualized and cut across well

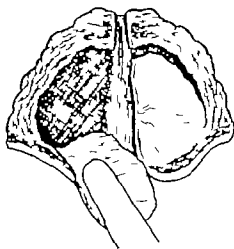


FIG. 441—Delivery of the left lateral lobe through the internal sphincter

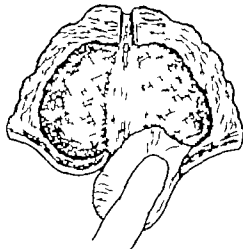


FIG. 442—Delivery of the right lateral lobe through the sphincter

in front of the palpable median lobe. In some cases the attachment of the lateral lobes free but still attached to the prostatic urethra the median lobe is peeled off the internal sphincter and the three lobes delivered into the bladder through the sphincter. The attachment of

the median lobe to the prostatic urethra is then divided (Figs 447, 448, 449 and 450) and the prostate removed

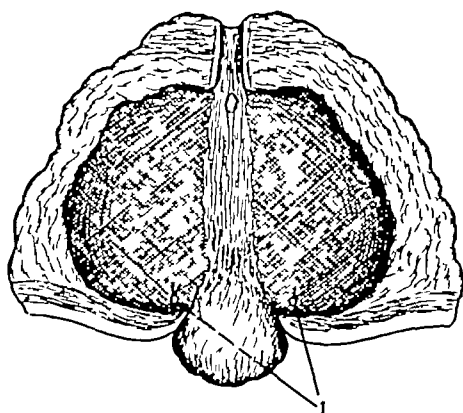


FIG 443 —The cavity of the prostate after the lateral lobes are removed showing the approximate position (No 1) where the prostatic vessels lie. The median lobe untouched and attached to the floor of the prostatic urethra

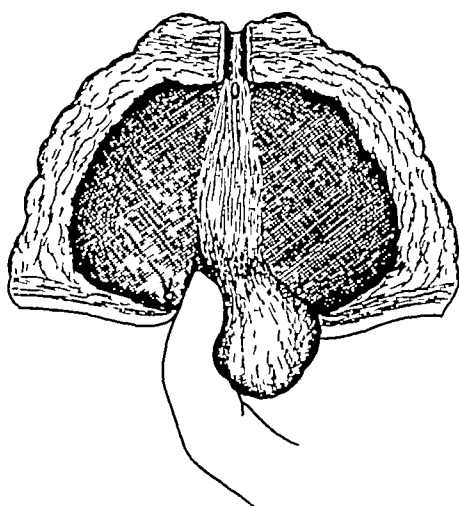


FIG 144 —The finger enucleation of a median lobe. The separation has been begun under the edge of attachment to the lateral lobe

Enucleation of the Prostate, Digital and Visual —In a comparatively thin subject, where the prostatic hypertrophy projects well into the bladder and can be easily visualized after bladder retraction, it can be

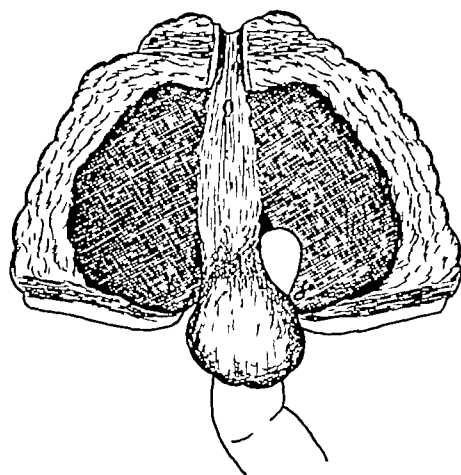


FIG 445 —The finger enucleation of the median lobe with the separation complete. The lobe is peeled off its attachment to the posterior edge of the internal sphincter

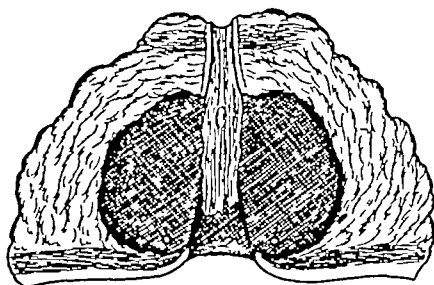


FIG 446 —The prostatic cavity after removal. The projecting bladder wall and internal meatus has contracted down to the normal position. The floor of the prostatic urethra is shown torn across in front of the middle lobe. The prostatic capsule has contracted lessening the size of the cavity

removed in part by finger separation and in part by dissection under vision. The enucleation is begun in the manner described under digital

removal. Both lateral lobes are freed digitally back to the attachments of the blood-vessels and to the prostatic urethra near the middle lobe. The bladder retractor is then inserted and under visualization

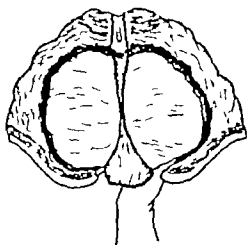


FIG. 447—Separation of the right lateral lobe

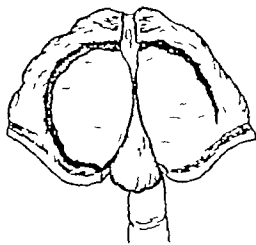


FIG. 448—Separation of the median lobe and right lateral lobe

and with prostatic traction forceps first one lobe is lifted back into the bladder through the undamaged internal sphincter (Fig. 441). If possible the vessels of the prostate are clamped before final freeing of the lateral lobes.

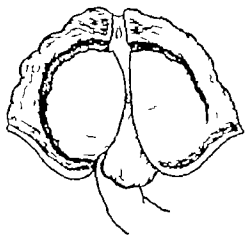


FIG. 449—Separation of the left lateral lobe and median lobe from the internal sphincter

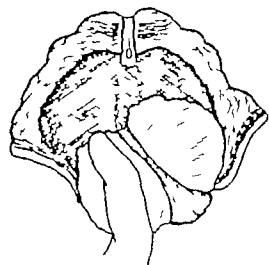


FIG. 450—Delivery of the three lobed prostate through the internal sphincter

First one lateral lobe is deflected to the median line and the edge of the sphincter retracted and the vessels clamped if recognized. The opposite lobe is then delivered in a similar manner and the vessels clamped. If large the lateral lobes are then removed separately (Fig. 452). The median lobe is then seized with traction forceps and

stripped off the internal sphincter, and traction made upon the median lobe exposing the prostatic urethra, and this is cut at a point well in front of the median lobe (Fig 453)

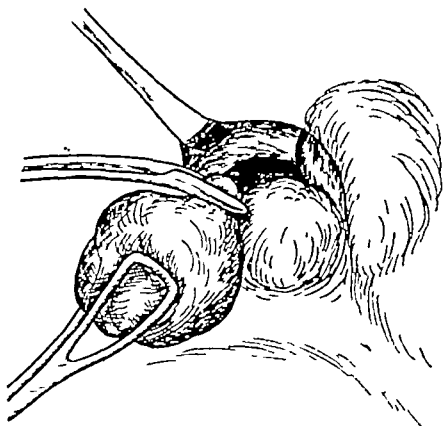


FIG 451 —Digital-visual removal The left lateral lobe has been delivered and the prostatic vessels are grasped with forceps

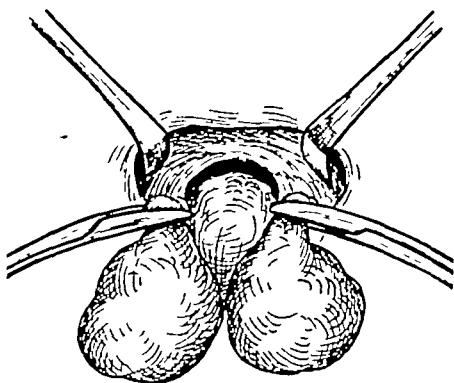


FIG 452 —Both lateral lobes have been delivered and the vessels seized with forceps

The bleeding from the separation of the lateral lobes up to the separation of the prostatic vessels is usually slight and interferes little with the visualization of the steps. The bleeding from the separation of the median lobe is small in amount.

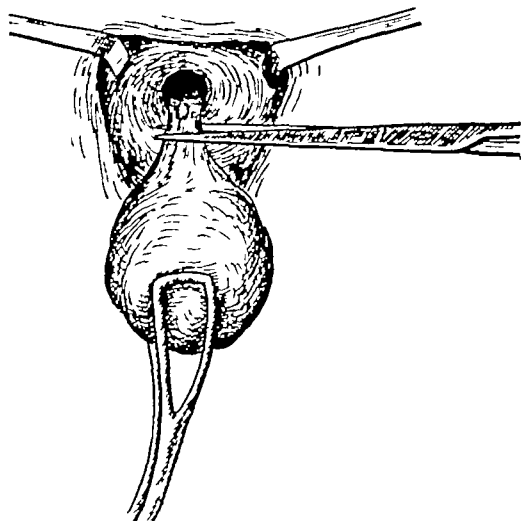


FIG 453 —The lateral lobes have been removed and the vessels ligated. The median lobe has been separated from the floor of the internal sphincter after traction with the forceps. The prostatic urethra is divided proximal to the verumontanum.

Enucleation of the Prostate, Visual — In cases with well presenting intravesical intrusions in those subjects that can be adequately exposed it is possible to remove the prostatic hypertrophy by dissection. With bladder retractors and adequate illumination, the lateral lobes can be separated through the dilated internal sphincter and a traction forceps applied. With traction upon first one lobe, and blunt dissection, this lobe is lifted out of the prostatic capsule. When the vessels in the lateral inferior angle are reached they may be recognized, clamped

and ligated. The median lobe is then seized in turn and stripped off the internal sphincter and freed on its pedicle of prostatic urethra.

The prostatic urethra is divided in front of the median lobe. In this procedure there is usually a minimum of bleeding and trauma as practically all the dissection is against the glandular hyperplasia to be removed.

The reasons for the superiority of removing the prostatic hyperplasia by the intra urethral method are as follows:

- 1 Prostatic hypertrophic glandular changes occur in the urethral or peri-urethral portions of the prostate.
- 2 These are best reached through the urethra.
- 3 The lines of cleavage are here best developed.
- 4 There is less damage done to the prostatic capsule if present and to the periprostatic plexus of veins.
- 5 There is no damage to either sphincter external or internal.
- 6 There is less damage to the trigonal muscle.
- 7 The prostatic vessels are separated late and bleeding from them may frequently be controlled.
- 8 It is possible to preserve the verumontanum and underlying ejaculatory ducts.

Inspection of the Prostate for Completeness — After removal the lobes are reassembled whether attached or separated to determine the size and outline of the gland. Defects in configuration should be studied to determine whether accessory nodules have been overlooked and left behind in order that they may be searched for and removed.

Inspection of the Prostatic Fossa. — Digital examination of the prostatic bed may reveal whether any firm areas are present which may represent unremoved lobules. Visual inspection with illumination introduced into the prostatic cavity may reveal such lobules and they should be removed (Fig. 4-4). The remnant of the prostatic urethra as well as the edge of the internal sphincter is examined to remove any tags of capsular tissue or of mucous membrane.

Control of Bleeding — The amount of bleeding during removal of the prostate is influenced by a number of factors. Unusually large prostates have as a rule a greater blood supply than smaller ones and the amount of bleeding at operation frequently varies in proportion to the size of the prostate. If the prostatic capsular area contracts slowly and if the vessels are not ligated hemorrhage may be profuse. In those cases where the lines of cleavage between the lobes of the prostate and the capsule are poorly developed more trauma may occur during the enucleation with consequent increased hemorrhage.

The first source of bleeding is largely from severed prostatic vessels. These branches of the inferior vesical arteries are situated on the posterior lateral aspect of the prostate not far from the inferior lower edge of the internal sphincter. Control may be affected by clamping the vessels and ligation or may be controlled by placing sutures through the posterior angles of the sphincter as suggested by Lower and by Harris. The second source of bleeding is the general ooze from the prostatic bed. This is to a large extent controlled by the contraction of the fascia outside the cavity formed by the removal of the prostate.

In some cases, pressure pads temporarily applied to the raw surfaces of the cavity suffice. In others, various measures are necessary and may be used. Harris suggests

the use of sutures across the anterior half of the sphincter deep into the fossa (Figs 455 and 456), the idea being to obliterate the anterior portion of the fossa.

Control of the bleeding by clamp and ligature or by suture are the best surgical procedures. The material used should be absorbable because of the tendency of foreign material left in the bladder to form a nucleus for urinary encrustations. Ligatures or sutures should not include any more tissue than is essential to stop the hemorrhage. Ligation of the vessels only, is theoretically the best method. If, because of considerable tissue being included in a ligature, an area of necrosis should form, infection, slough and

possibly secondary hemorrhage may be the result. Great care should be taken, when using sutures to check bleeding, not to penetrate the rectal wall with the needles carrying the sutures.

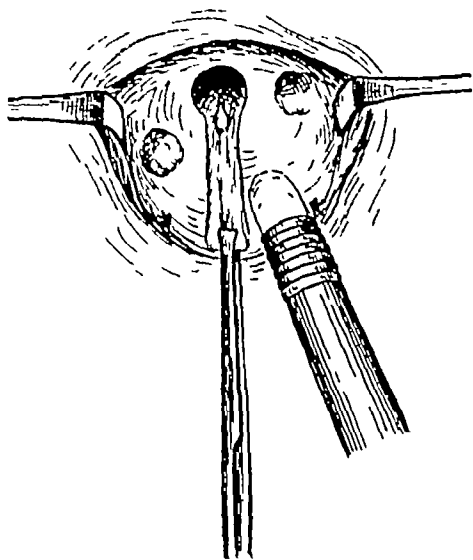


FIG 154 —Illuminated visual inspection of the prostatic cavity showing two small adenoma in the prostatic capsule. The floor of the prostatic urethra is held in forceps.

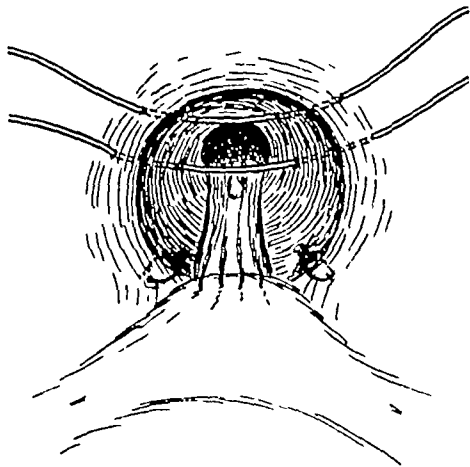


FIG 155 —Suture ligatures of prostatic vessels. Sutures in anterior portion of prostatic cavity to obliterate the same. The floor of the prostatic urethra is sutured to trigonal edge.

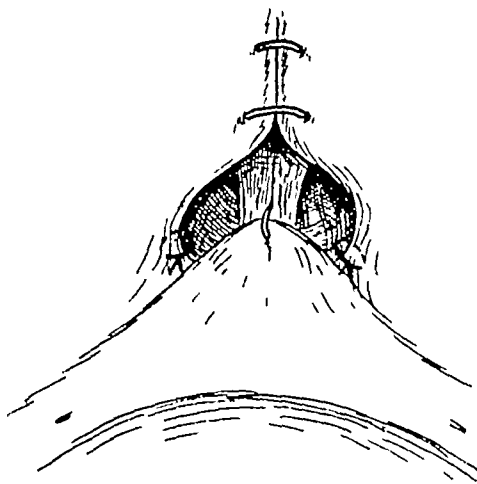


FIG 156 —Suture ligatures of the prostatic vessels. Sutures in anterior portion of prostatic cavity. Suture holding trigonal musculo edge to floor of prostatic cavity and prostatic urethra.

Control of bleeding by mechanical methods has been recommended and used successfully by many surgeons. Among the early devices

was Hagner's bag and later others—modified by Pilcher, Hauser, etc. These devices are urethral catheters to which a cone-shaped rubber bag is attached and when properly inserted the bag lies in the cavity formed by the removal of the prostate. The bag is distended and by its distention and by traction on the penile catheter to which it is attached, compression is made against the prostatic fossa. The control of the ooze from the prostatic bed is good. The control of the larger vessels may or may not be good. The bags are usually removed through the suprapubic wound when hemostasis has been accomplished. There are certain dangers associated with the use of bags. Too much or too long pressure may be followed by necrosis of the so-called prostatic capsule and of the remnant of the floor of the prostatic urethra. If infection is present it may be disseminated by pressure. If necrosis from pressure occurs it may be followed by secondary hemorrhage after the slough separates. Stricture from excessive scar formation is a possibility.

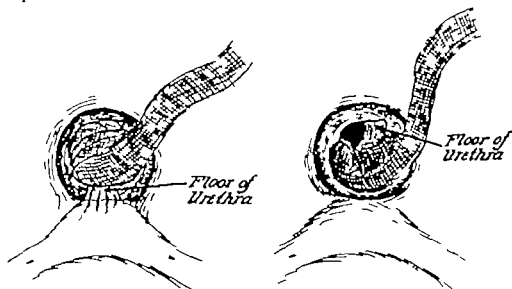


FIG. 457.—The control of bleeding from the prostatic bed. The packing is applied above the floor of the urethra.

FIG. 458.—Packing improperly placed below the floor of the urethra. This will cause the floor of the urethra to adhere anteriorly and result in stricture.

The bleeding may be controlled by packing. If this is done care must be taken in placing the packing so that the floor of the prostatic urethra is not pushed up behind the triangular ligament for if this occurs postoperative urethral occlusion may result (Figs. 457 and 458).

Repair of the Vesical Neck.—With the bladder wound widely retracted and with illumination all excess tags of prostatic mucosa and of the internal sphincter should be removed. After the prostatic cavity has been cleared of any accessory lobules and the internal sphincter of all tabs and bleeding controlled restoration of the floor of the prostatic urethra is attempted. In some patients this is not possible especially if the median lobe has involved most of the urethral floor. Harris repairs the vesical neck by bringing the floor of the sphincter down

into the prostatic fossa and anchoring it by a suture passed through the floor of the prostatic bed (Fig 455) This is difficult The edge of the internal sphincter is not readily pulled into the fossa and the passage of the suture through the bottom of the prostatic cavity may pierce the rectal tissues Anatomically the floor of the bladder neck is pulled out of position if extended into the prostatic fossa The floor of the prostatic urethra is lengthened in prostatic hyperplasia At operation a certain portion of the prostatic urethra in front of the median lobe comes away The portion unremoved includes the veru This portion, after the prostate is removed, is free and may be sufficiently long so as to reach the edge of the internal sphincter after the sphincter has contracted to its more natural position This remaining urethral portion containing epithelium, subepithelial tissue and fascia can be sutured to the floor of the sphincter and edge

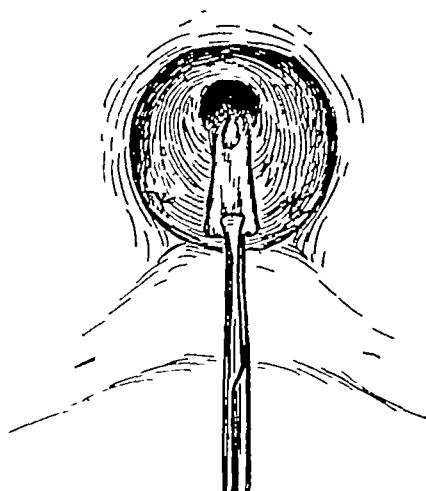


FIG 459 —The prostatic cavity after complete removal

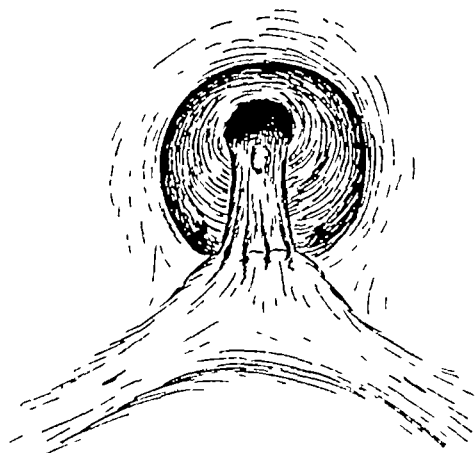


FIG 460 —The floor of the prostatic urethra has been sutured to the floor of the sphincter including the trigone muscle

of the trigonal muscle (Figs 459 and 460) The sutures should be absorbable It is also possible to hold this portion of the remaining urethra to the edge of the sphincter by the proper use of gauze strips in cases where suturing is undesirable or difficult to accomplish

Placing a circular group of interrupted sutures so as to approximate the remaining prostatic urethral mucous membrane to the sphincter has been suggested This is impossible because the mucous membrane of the lateral walls of the prostatic urethra comes away with the prostatic lobes

Prevention of Bar at Sphincter —In cases in which edema of the mucous membrane of the floor of the internal sphincter is marked and in which there has been associated hypertrophy of the trigone, the floor of the internal sphincter may be seen elevated in a bar obstruction This is increased by the contraction of the trigonal muscle beneath (Figs 461 and 462) Removal of the edematous mucous membrane

in a wedge-shaped area is done to prevent this bar (Fig. 463). In these cases if the sphincter edge is sutured to the prostatic urethral floor the sutures should be deep to include the underlying trigonal

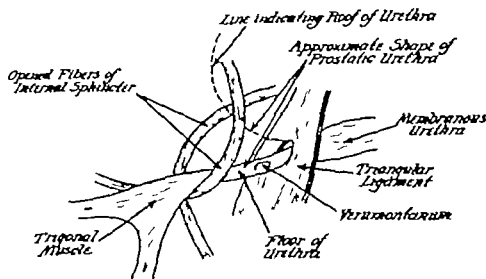


FIG. 461.—A diagram showing the normal prostatic urethra with the trigonal muscle contracted and the fibers of the internal sphincter opened. The floor of the urethra is flat.

muscle. This procedure produces little hemorrhage and leaves the floor of the sphincter flat. The removal of the wedge-shaped area is not followed by any loss of vesical control (Fig. 464).

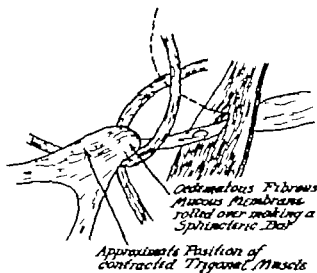


FIG. 462.—A diagram similar to Fig. 461 showing that when an edematous, fibrous bladder mucous membrane is rolled over and increased in size by the contraction of the trigonal muscle it makes a sphincteric bar.

Drainage Suprapubic—The most suitable type of postoperative bladder drainage requires the use of a drainage tube sufficiently large

to permit of aspiration and for the introduction of an For this purpose the Freyer tube is admirable It is sutured to the upper angle of the bladder wound projecting into the bladder so as to be well within its cavity, but not deep enough to impinge upon the prostatic area, about

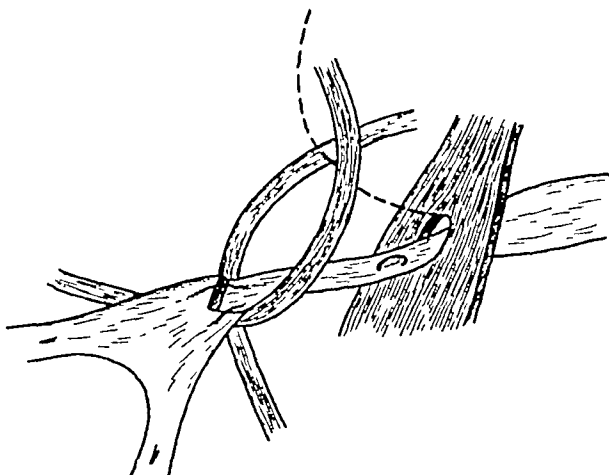


FIG 463 —A diagram similar to Fig 462 showing the restoration of the attachment of the trigonal muscle to the urethra after removal of the bar effect

1½ inches is the average It is held in place by a catgut suture passed through the outer fascia of the bladder so that the cut edges of the epithelium and muscularis are inverted toward the bladder cavity That portion of the bladder opening in front of the tube is closed with inversion sutures through the outer fascia and muscularis If any

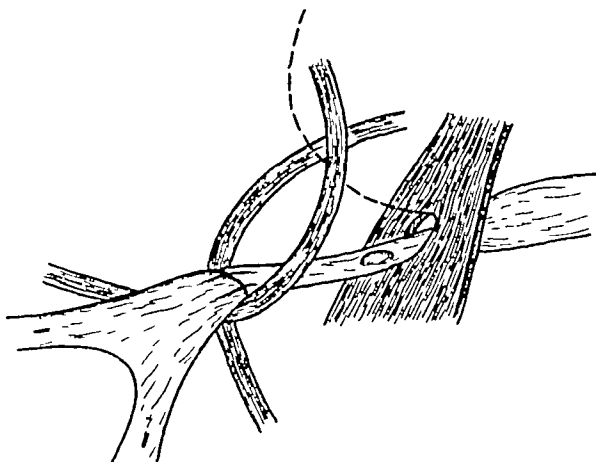


FIG 464 —A diagram similar to Fig 463 showing the restoration of the urethra after prostatectomy

tissue or packing material should be used, it is brought out of the bladder opening directly in front of and next to the Freyer tube

The insertion of the drainage tube at the summit of the bladder allows the bladder to fall back deep into the pelvis, produces a sinus

that is farthest from the bladder neck and in a collapsible and movable portion of the bladder and makes for early closing of the suprapubic sinus, after the tube is removed.

Drainage—Urethral.—In cases in which the hemorrhage has been controlled certain authors have completely closed the bladder wound by suture. Drainage being provided for by an indwelling urethral catheter held in place by a suture of silkworm gut passed out through the closed suprapubic opening. The sutures of the bladder are of the inversion mattress or purse-string type. The abdominal wound is closed with prevesical drainage only.

Drainage—Discussion.—Drainage of the bladder before prostatectomy either by urethral catheter or by the suprapubic opening has been is and will be one of the largest factors in reducing the dangers incident to prostatic operations and has been an important factor in reducing operative mortality. With the trauma incident to prostatectomy and with the bleeding that always occurs to some degree in spite of how possible it is to ligate the torn vessels—and with the serous ooze from the prostatic bed postoperative drainage by urethral catheter may and can be accomplished only by meticulous care and frequent irrigation. Often it fails, in spite of the utmost care. The frequent irrigation necessary increases the risk of leakage into opened fascial planes, either in the prostatic or in the perivesical areas. If epithelial structures are too tightly sutured pressure necrosis occurs and leaking takes place. The desire to reduce the period of postoperative hospitalization by complete closure of the bladder is of doubtful value along side of its dangers. With proper suprapubic drainage and with inversion of the bladder mucosa a short period of drainage is the rule. The risk of leakage extravasation and infection into the perivesical space when suprapubic drainage is carried out becomes a more remote possibility. It is much more likely to happen with urethral catheter drainage. Undoubtedly suprapubic drainage is safer.

Prevesical Drainage.—After the suprapubic bladder tube has been properly fastened and the bladder closed anteriorly and inferiorly to the tube a cigarette drain is placed in the prevesical space and brought out the wound inferior to the tube. This is done to drain the slight serous ooze which comes from the prevesical space. In addition it is a means for further protection in case any spilling of urine has occurred at the time of opening the bladder and in case a leak occurs into the prevesical space from that portion of the bladder wound inferior to the Freyer tube.

Closure of the Wound.—The bladder having been dropped back down into the pelvis with the prevesical drain brought out of the abdominal wound at its lower angle, and the Freyer tube next above the fascia of the recti muscles is sutured from above downward with chromic catgut. The suture is made down to the Freyer tube but not tightly around the same. The tube should be free from pressure by the lines of suture so as to be sure of perfect prevesical drainage.

Silkworm gut stay sutures are passed through skin and rectus fascia. The skin is then closed with silk suture down to the Freyer tube, but not closed tightly around the tube.

PROSTATECTOMY TWO-STAGES

Patients suffering from urinary obstruction produced by prostatic hyperplasia, in which preliminary decompression, either by periodic catheterization or by indwelling catheters is impossible or unsatisfactory, may require a two-stage prostatectomy, a first stage for bladder drainage—a second for removal of the prostate. These patients can be grouped somewhat as follows:

- 1 Those in which it is impossible to pass a catheter
- 2 Those in which intravesical hemorrhage has occurred spontaneously or from traumatism—and it is impossible to evacuate the retained clots by urethral instrumentations
- 3 Those whose bladders or urethras are intolerant to indwelling catheters. The presence of the retention catheter frequently increases the inflammation either of the bladder or urethra and predisposes to further complications such as epididymitis, prostatic abscess or pyelonephritis
- 4 Cases in which the complicating presence of bladder calculi interferes with catheter drainage of the bladder, causing the inflamed mucous membrane to be more irritated, and producing bleeding or obstruction of the catheter
- 5 Cases of large diverticula with infection in which removal of the diverticulum becomes indicated at the first stage
- 6 Cases with pathological disturbances, either urological or otherwise in which a long period of drainage is necessary to produce improvement in general condition before submitting the patient to the operative risk of prostatectomy. The most common urological condition is severe renal impairment. The most common general condition is associated cardio-vascular disturbances

A two-stage opening of the bladder has even been advised in order to avoid infection of the abdominal wound and perivesical spaces in cases in which severe vesical infection exists. At the first step, the abdomen is opened down to the bladder and traction sutures placed in the bladder and the wound packed. The packing is removed the following day or so and then the bladder opened, and a drainage tube is inserted into the bladder with a minimum of wound disturbance.

First Stage.—The position and preparation are the same as for one-stage prostatectomy. The patient is prone on his back on the table fixed for Trendelenburg position. The bladder is distended with fluid through a urethral catheter.

Incision.—The classical vertical incision is made higher than the one-stage incision. The lower end is about $1\frac{1}{2}$ inches above the pubic bone. The incision is shorter, usually about 3 or 4 inches in length. The skin and subcutaneous tissues are divided. The anterior rectus sheath is

opened and the recti separated. The transversalis and prevesical fascia are opened and the peritoneum is reflected off the upper portion of the bladder. The bladder is then identified as described above and seized by traction forceps. It is opened near its vertex with a scalpel and the aspirator immediately introduced and the bladder is entirely emptied.

Exploration—Diverticula.—If the first stage is used for drainage in cases where it has not been possible to catheterize or cystoscope a thorough examination may be done by palpation to determine the condition of the prostate and of the bladder. Blood clots and calculi if present are removed. If a large diverticulum is present and the patient

has but little complicating infection it may be wise to remove the diverticulum at the first stage because the various fascia layers are then more apt to be free identifiable and dissectible than at a later time after continued drainage. Large diverticula with prostatic obstructions are removed by the extravescical approach. The adventitious fascia of the bladder is divided over the mucosa and fascia of the diverticulum and the diverticulum then freed from its external fascia to its neck. It is there divided at the muscle layers of the bladder and the neck closed with a suture inverting the muscularis and mucosa into the bladder. By this method the diverticulum may be removed from its attachments to surrounding tissues by open and visual dissection and without disturbing the bladder except at the opening of the diverticulum. Small diverticula may be inverted into the bladder by traction or by suction from the bladder cavity and then removed and the opening closed.

In cases in which a two-stage prostatectomy is necessary and there is an associated bladder tumor the removal or destruction of the tumor should be a part of the first stage operation.

Type of Drainage.—In cases of severe infection in which the prostate is not too large nor too vascular the use of a Freyer tube with aspiration gives the most satisfactory drainage and tends to a more rapid disappearance of the infection.

In cases in which the prostates are very large or vascular a Pezzer

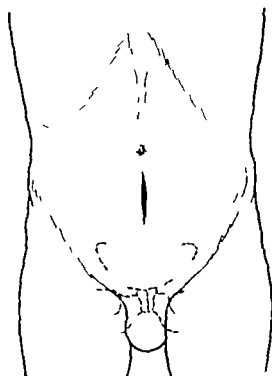


FIG. 463.—Incision for two stage prostatectomy. It is well above the symphysis pubis and below the umbilicus.

Silkworm gut stay sutures are passed through skin and rectus fascia. The skin is then closed with silk suture down to the Freyer tube, but not closed tightly around the tube.

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Removal of the Prostate — The methods are the same as described under one-stage operation either digital only digital visual or visual. As a rule the prostatic separation is more difficult. The period of drainage having reduced the edema and inflammation of the prostate and of the surrounding planes, there appears to be an increase in fibrous fixation of these planes. Digital removal is usually necessary and visual inspection of the prostate bed done secondarily. The bleeding is apt to be somewhat more difficult to control but is usually less in amount. Ligation of the vessels is more difficult. Packing as a control may be necessary because the ooze from the prostatic bed may be the more marked part of the bleeding. As a rule this is not required. Due to the fixation of the wound repair of the vesical neck by suturing is usually more difficult.

Drainage — A Freyer tube is fastened to the upper angle of the bladder wound with an inversion catgut suture. Due to the smaller bladder capacity about an inch only of the tube is allowed to project into the bladder. Care should be taken that the bladder mucosa is inverted and the fundus of the bladder has been sufficiently mobilized so that the bladder may be dropped well down under the recti muscles. The opening in the bladder below the Freyer tube is closed with inverting catgut sutures. A prevesical cigarette drain is inserted inferior to the Freyer tube.

Closure — An interrupted catgut suture of the recti muscles will prevent protrusion of any of the transversalis fat or of the anterior wall of the bladder. The external rectus fascia is separated on each side and closed from above downward with chromic catgut. Silkworm gut stay sutures are passed through skin and fascia and the skin closed with continuous silk sutures.

GENERAL CONSIDERATIONS

In my experience the great majority of patients who come to operation are those in whom it is difficult to carry out many of the refinements of operative technique which have already been described.

They are patients who should not be subjected to a long anesthesia or to prolonged surgical procedure which many of the refinements of delicate bladder neck restoration necessitate.

As I quoted the operation should be but an incident in the treatment. Therefore expedition compatible with thoroughness and safety is most desirable and in the majority of instances this means a rapid exposure of the bladder its evacuation by aspiration a finger exploration of its interior a visualization by means of a self-retaining retractor a finger enucleation of the prostate a second insertion of the retractor with the removal of any tags of unremoved prostatic nodules an immediate packing of the cavity left by the removed prostate to control oozing and clamping the lower edges of the internal sphincter to stop arterial hemorrhage. Allowing the packing to remain a few minutes will in many instances be sufficient to stop active oozing and like-

catheter or some similar type is inserted into the summit of the anterior wall of the bladder. Such a drain does not come into contact with the prostate and, therefore, is more easily tolerated.

In those patients in whom drainage of the bladder has to be carried out for a long time, attachment of one or both edges of the bladder mucosa to the rectus fascia with catgut sutures, before the insertion of the retention catheter, will enable the catheter to be more easily removed and reinserted.

Drainage of any opened portion of the prevesical space is to be taken care of by insertion of a cigarette drain. At the time of the first stage, this space should be disturbed as little as possible, not alone to prevent infection, but that the separation of the fascial planes will be easier at the second stage and the elasticity of the bladder retained, both of which allow easier enucleation of the prostate at the second stage.

Closure of the Incision — If necessary the anterior rectus sheath is closed from above downward to the retaining catheter with catgut. The fascia is loosely approximated around the catheter. Retention sutures of silkworm gut are passed through skin and fascia. The skin may be closed with silk. The catheter and drain are not to be sutured tightly at any plane. If sutured tightly, there is increased risk of wound infection which, if followed by excessive cicatrization, fixes the wound, thus forming a handicap to free mobilization of the bladder at the second stage.

Second Stage. — The position and preparation are the same as for the first stage.

An elliptical incision is made around and very close to the drainage opening. The skin and subcutaneous tissues are divided from just above the pubis to below the umbilicus. The rectus fascia is divided above and below the drainage opening. If the prevesical space has not been opened at the previous operation it is now opened after freeing the transversalis fascia, and the anterior wall of the bladder exposed. This will quickly show the line of inflammatory attachment of the bladder to the recti muscles or fascia and the bladder is then detached from both. It is necessary to mobilize the anterior wall of the bladder. If not properly mobilized, the fixation may split the upper portion and open the peritoneum during the manipulation necessary to remove the prostate. If the peritoneum has been accidentally opened, the bladder and other fascial planes should be mobilized and the peritoneum at once repaired. After the anterior wall of the bladder has been freed, the sinus is enlarged downward as far as necessary.

Exploration of the Bladder — Inspection of the bladder is more difficult in the second stage due to the fixation of the tissues. Proper mobilization of the anterior wall of the bladder however gives, as a rule, sufficient relaxation for both digital and visual inspection. The prostate decreases in size after prolonged drainage. The bladder wall, having been contracted over a long period, will be of greater thickness and the cavity will have become smaller.

Similarly important in the postoperative period both early and late is attention to the intestinal tract

The critical period seems to be within the twenty four hour and seventy two hour period. It is where a persistent nausea or beginning singultus may be the first sign of uremia. It is at a turning point such as this that the information gained from a chemical blood examination is of invaluable aid to demonstrate the degree of nitrogen retention.

The suprapubic cigarette drain is removed from forty-eight to seventy-two hours after operation, depending on the degree of infection present in the bladder.

The suprapubic bladder tube is removed usually in from four to six days. This we think should depend on three factors. 1. The condition of the bladder as to surgical cleanliness—in a clean bladder early in a suppurative condition late. 2. The amount of ooze and clots. The tube should be kept in until all blood clots have come away and all ooze has ceased. 3. The tube should be kept in until there is a well lined granulation tissue fistula formed so that on removal of the tube there will be no urinary infiltration laterally along the fascial spaces and planes.

After the removal of the Freyer tube aspiration of the bladder contents is continued by the use of the Cole disk. The bladder is washed several times daily by a catheter inserted through the suprapubic wound.

Urethral irrigation of the bladder should be carried out only after the suprapubic sinus becomes too small to admit a catheter.

Patients may safely be set up in bed in six or seven days and allowed out of bed in from ten to twelve days but as these are old men they should be treated as such and getting an old man up and out of bed a few days after a major operation is poor policy. It is like whipping a tired horse. Keep him interested and alive mentally and make his surroundings pleasant.

The suprapubic fistula heals usually in from two to four weeks, on the average three weeks. In those that remain open longer it may be necessary to irrigate more often through the urethra. In an exceptional case it may be necessary to insert a retention catheter and drain the bladder so that the fistula will heal.

When the patient starts voiding he should be encouraged to empty the bladder frequently. It seems good judgment in those patients who before operation had large stretched overdilated trabeculated bladders to allow the suprapubic fistula to remain open longer than routine so as to restore by rest the lost bladder tone as well as cure the existing cystitis.

The final word will never be said on just what constitutes an ideal routine for postoperative prostatic treatment.

More difficult problems come up in the management of these cases than perhaps in any other branch of surgery.

The resources of the surgeon are often taxed to the utmost but in no

wise leaving the clamps on the blood-vessels for a similar period will suffice to control hemorrhage. By the time the Freyer tube is sutured in position, the clamps and packing may be removed and then the lower angle of the bladder wound closed.

The prevesical drain is inserted and the operation is completed by closing the abdominal wound.

Prostatectomy carried out in this way can be accomplished in a minimum space of time and with the minimum shock to the patient. Anesthesia may be discontinued almost as soon as the closure of the abdominal wound is started.

POSTOPERATIVE CONSIDERATIONS

The postoperative period of a prostatic patient's surgical journey is scarcely less important than the preoperative, and an immediate appreciation of the development of untoward incidents is the determinant of success.

Remember always, that prostatic surgery is major surgery carried out upon patients at a time in their lives when resistance is lowered, degenerative changes have become manifest, and for these reasons they should receive the closest attention and care.

Shock—There may be a mild shock shortly after operation, or it may be delayed a few hours.

To guard against this, the amount of bleeding is closely watched and, if undue in amount, or the patient shows effects of hemorrhage, infusion or transfusion should be at once given. The use of blood transfusion has reduced the dangers of prostatic surgery to a very great degree. Immediately following operation siphon drainage of the bladder is instituted. This is accomplished by inserting a small rubber catheter to the bottom of the Freyer tube and attaching it to a vacuum bottle on the side of the bed.

The patient, upon recovering from anesthesia, is given one or two hypodermic injections of morphine which usually is sufficient to allay the vesical spasms which the removal of the prostate has produced. The continued use of morphine, as is well known, decreases all secretions except that of the skin, and in prostatics keeping the kidneys properly functioning after operation is one of the most important considerations. The use of any drug which might interfere with renal activity is contraindicated.

In many cases it is wise to give the patient sodium benzoate of caffeine hypodermically shortly after operation to forestall possible renal insufficiency.

Renal insufficiency is one of the great dangers after operation, in a like manner to the preoperative period, and here again is where the extent of its presence can be best determined by chemical blood examination. Approaching chemical unbalance of the patient can be early recognized and measures at once instituted for correction before a grave condition develops.

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other branch of surgery does a case well managed, and brought to a final successful functional restoration, produce a result more gratifying to both patient and surgeon

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formations. Many of the latter also advocate the use of the procedure in the extremely debilitated individual who cannot stand a prostatectomy and who before the days of resection would have been advised to satisfy himself with a catheter life.

There is no question but what the operation of resection is difficult and when undertaken in the case of large hypertrophies is tedious in the extreme to the operator while a prostatectomy is an easy operation for the operator but carries a much greater risk for the patient.

If a procedure is safer for the greatly debilitated it must of necessity be safer for the normal cases and it is difficult to understand how a procedure that is admittedly more dangerous can be recommended simply because it is easier for the operator.

If the surgeon is equally dexterous both through the urethra and through the bladder there will be but few cases in which he will recommend prostatectomy. If he is not so dexterous with urethral instruments he will confine his efforts to the smaller hypertrophies and the greatly increased risks leaving prostatectomy for the more robust patients who he thinks can stand the perils of a prostatectomy.

Ballinger has suggested the suprapubic excision of the intravesical portion of unusually large glands to be followed later by resection thus avoiding the dangers incident to enucleation of these huge masses of tissue.

Cancer of the prostate has to date defied any surgical means of cure but transurethral resection affords a palliative measure that establishes satisfactory function and does away with the necessity of constant catheterization or permanent suprapubic drainage.

Few of these patients live long enough to require a second operation but if they do it is not a serious undertaking and never looked forward to with the horror that attended the anticipation of a second partial prostatectomy. Occasionally the cancer will invade the external sphincter with resulting incontinence which should not be attributed to the resection unless it occurred immediately after the operation. Some have claimed that there is a deleterious effect on the cancer exerted either by the high frequency current itself as it passes through the tissue or by the toxic end products of tissue destruction. These remain simply clinical observations and lack scientific proof.

REMOVAL OF TISSUE.

Irrespective of the size of the obstruction or the instrument used there are certain fundamentals that must be followed if a rapid and satisfactory convalescence with good functional result is to ensue.

Time should always be taken before resection carefully to examine the entire field and ascertain what portion of the gland is causing the obstruction determining how much tissue it will be necessary to resect and from what location. Landmarks such as the ureteral orifices the interureteric ridge and the verumontanum should be located and carefully examined to determine their relationship to contiguous

close. Therefore, Fuller, in America, and six years later Fieyer, in England, undertook to carry out what they considered complete enucleation of the gland and, as all the obstructing tissue was necessarily removed along with an enormous amount of non-obstructing tissue, then results were far superior to those of the surgeons who had done only partial prostatectomy. Thus was firmly established the belief founded on false premises that the functional results following partial prostatectomy are bound to be inferior to those following enucleation. Few stopped to consider that the success of partial prostatectomy depended not on the quantity of tissue that was removed but from what location it was excised. As a result, the surgical world with comparatively few exceptions espoused the doctrine that complete prostatectomy was the procedure indicated in cases of benign hypertrophy and devoted their attention to efforts at reduction of its mortality.

Although marked improvement has occurred as a result of preoperative preparation, the rate of mortality remains the highest of any surgical procedure directed toward the relief of a benign condition. Furthermore, although the not infrequent poor functional results following prostatectomy are common knowledge to the initiated, reviews of them are seldom published.

Realizing these unpleasant truths, those in the profession with a pioneering spirit were on the alert to find some better method of treatment than removal of an entire gland simply because a small portion of it was obstructing the urinary outflow in a channel as accessible as the urethra. Yet, to operate successfully in such a situation, it was essential that the instrument used be capable of removing all the obstructing tissue no matter how extensive, since to remove only a portion of the tissue in the presence of residual urine will aggravate, not improve, the symptoms from which the patient is suffering.

The operation should be carried out under such conditions that the obstructing portions of the gland can be seen and their relationship to other structures determined before their excision and some method provided for adequate control of bleeding.

These requirements have all been met in various ways by the different instruments now available for transurethral resection.

SELECTION OF CASES.

The weight of a normal prostate gland is in the neighborhood of 25 grams. When enlarged from fibroadenomatous hyperplasia this may increase to over 200 grams but such great enlargement is the exception. An examination of the tissue removed in 575 suprapubic prostatectomies at the Mayo Clinic showed but 32.1 per cent to weigh more than 50 grams.

Some authors, notably Alcock, feel that the only contraindication to resection is the inability to pass the instrument, while others maintain the procedure should be confined to smaller median lobes and bar-

formations. Many of the latter also advocate the use of the procedure in the extremely debilitated individual who cannot stand a prostatectomy and who before the days of resection would have been advised to satisfy himself with a catheter life.

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structures, as the tremendous deformity to the prostatic urethra incident to the enlargement of the gland greatly alters their normal relationship. Such a preliminary survey will save much time later in the procedure and insures the operator an accurate knowledge of the entire area before any tissue is resected.

The obstructing tissue should be removed widely enough from all portions of the vesical orifice to form an adequate channel from the verumontanum to the trigone. Once this is accomplished the operator will have an unobstructed view from the verumontanum into the bladder (Fig. 466). Care must, however, be exercised not to cut too

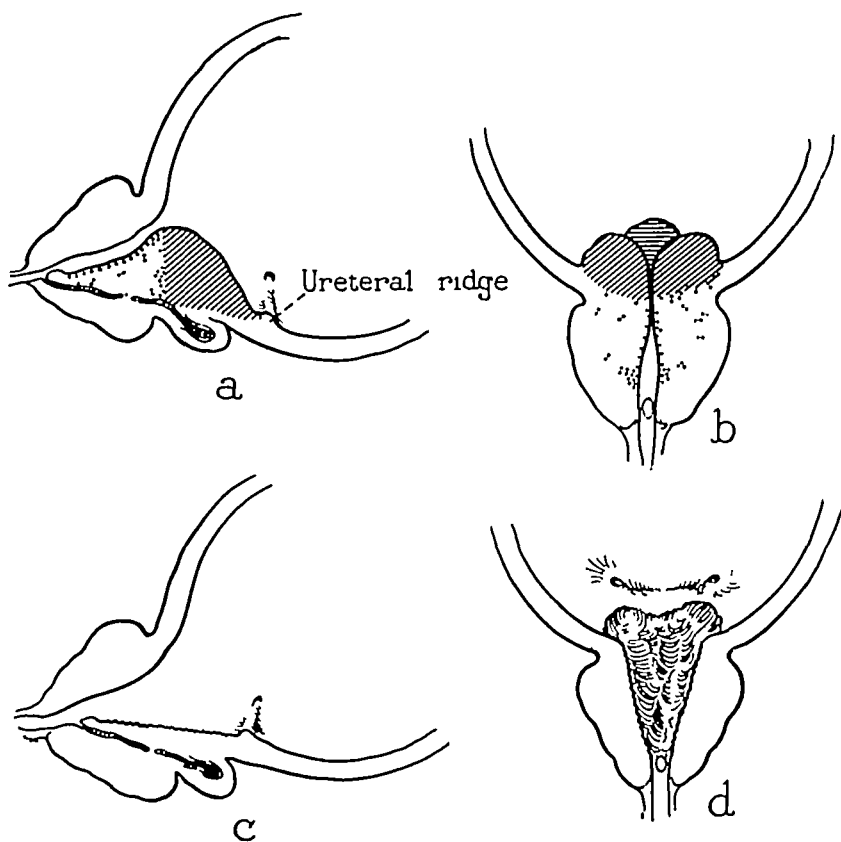


FIG. 466 — Diagram of the intravesical and intraurethral tissue it is necessary to resect in order to insure good functional results

deeply and only on the bladder side of the verumontanum, for this structure marks the beginning of the external sphincter and a single incision beyond it may produce incontinence. Davis has aptly likened it to the mariner's lighthouse—it is the point from which to chart one's course but to come too close is to court disaster and to destroy it is to lose one's bearings completely.

Transurethral resection is not intended to replace prostatectomy in that the major portions of the enlargement must be completely removed as in an enucleation. It may be necessary to remove large amounts of tissue in order to obtain a sufficiently wide channel but hypertrophied

tissue which does not impinge on such a channel need not be removed. This does not mean that the mere tunnelling of a passage into the bladder by excising the median lobe and resecting the lower borders of the lateral lobes is sufficient. The attempt at this half way measure has been undertaken by most operators early in their work. It will almost invariably result in ultimate failure although the obstruction may for a time be relieved. It differs in no essential from the forage method of Luys (Fig. 467) that was proved inadequate long before the operation of resection was developed. Failure results because such a tunnelling process leaves the roof of the urethra formed by overlapping lateral lobes and the urethra must be unobstructed throughout its circumference to function normally. The overlooking of an hypertrophy of

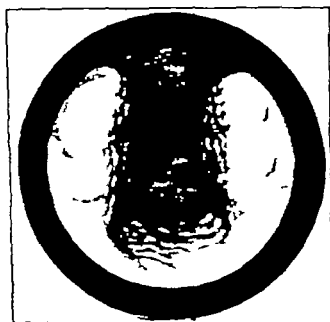


FIG. 467.—Lays' stage of the prostate showing channel coagulated through the glandular prostate and the large amount of prostatic tissue which remains and may perforce future obstruction either from continued fibromatous hyperplasia or as a result of the edema and congestion incident to the procedure.

the anterior portion of the gland produces a similar disappointing result for the same reason. In fact, a very insignificant amount of tissue hanging from the roof of the urethra may cause the most persistent symptoms of obstruction even when an apparently adequate channel has been formed. Fortunately such anterior lobe hypertrophies are rare and a careful preoperative survey will always reveal them and put the operator on his guard, especially if he has availed himself of a retrograde lens system such as are supplied with the Young and McCarthy instruments. The vision afforded by such a retrograde lens insures an adequate view of the anterior surface of the bladder above the prostate, a location which is difficult to visualize with any other instrument. It also gives one an opportunity to look on the distal side of

large hypertrophied lobes and for one who is contemplating doing many resections is indispensable.

If the obstruction is chiefly median, being confined to an intravesical enlargement of the subcervical glands of Albarran or hypertrophy of the commissural portion of the prostate, resection is simple and good functional results are assured no matter how great the obstruction, provided care has been taken not to leave any nodules in the region of the internal sphincter and the vesical lip has been left clean and free of tags, both of which precautions insure a smooth even healing and hence tend to better functional results.

Boyd has shown by doing prostatectomies on previously resected cases that the internal sphincter is usually cut during a resection and not infrequently some of the muscular fibers passing to the prostatic urethra through the lower portion of the vesical orifice. He thinks that much of the permanent benefit in resections comes from cutting this sphincter, for the relaxation of the vesical orifice which results from such cutting can only, he believe, explain the marked and immediate relief from obstruction that these patients experience.

If one uses the "punch" method of resection he can always tell by the tactile sense when these muscle fibers are being cut. While it gives a warning that the operator is beyond the prostatic tissue and must proceed carefully, it is no contraindication to further excision if its hypertrophy is causing an impingement on the circumference of the vesical orifice. Sufficient tissue, either prostatic, fibrous or muscular, must be cut away so that there is an uninterrupted view from the verumontanum to the trigone. At times this will necessitate cutting away a large part of the trigone itself if the commissural part of the gland is greatly enlarged.

The most difficult cases to resect are those in which the hypertrophy is entirely confined between the two sphincters. Alcock believes such cases are best treated by prostatectomy. Fortunately, their incidence is small, he encountering 4 in a series of 400. The difficulty encountered here is the tendency of the lateral lobes to fall away from the instrument, the procedure being not unlike bobbing for apples on Halloween. If an assistant places his finger in the rectum in such cases he can greatly facilitate matters by repeatedly forcing these lateral lobes into the fenestrum of the instrument or against the loop until sufficient tissue is removed.

If a sphincterotomy is done in this type of case with the Collings electrode before commencing the resection it also facilitates the removal of tissue and insures the symptomatic benefits to be derived by complete relaxation of the vesical orifice previously mentioned.

Most frequently there occurs some hypertrophy of all the lobes, in which case it is the general consensus of opinion that the median obstruction should be resected first. Once this is removed the lateral lobes will more easily fall into the operative field. The early removal of the median obstruction also makes the manipulation of the instrument easier and has the added advantage that, if for any reason it is

felt best to terminate the operation before completion the possibility of symptomatic relief is greater if the median obstruction has been removed than if either lateral lobe has been excised.

There is a feeling that the best cases for the inexperienced to undertake are those with small amounts of obstruction preferably of the median type. The fallacy of this idea has been called attention to by Thompson who writes: "True enough it will be necessary to remove only a small amount of tissue but since in such a case there is rarely thickening of the vesical wall subtrigonal hyperplasia or increase in the distance between the trigone and verumontanum the margin of safety will be less and excision of slightly more tissue than is intended might result in perivesical periprostatic or periurethral extravasation not to mention the possibility of postoperative incontinence. I believe that patients with benign moderate enlargements of the prostate gland or with prostatic carcinoma can be operated on with less risk than those with large prostatic glands or those with very little hypertrophy."

When there is doubt concerning the advisability of excising more tissue once a satisfactory channel has been constructed it is always best to be conservative. Cutting too deeply may cause extravasation of urine later and is bound to produce annoying bleeding. Tissue once removed cannot be replaced but this type of operation can most easily be repeated.

OPERATIONS IN MULTIPLE STAGES

Although it is usually possible to complete a resection at one time it is not always desirable as postoperative reactions seem to bear a direct relationship to the time consumed in the operation.

There are several reasons for this. The urethra always resents undue trauma and the importance of gentleness in the passage of instruments through it remains unchanged. In transurethral work these instruments are of larger caliber and remain in the urethra for long periods of time so that injury to the mucosa by the continual pressure of the operator's hand against the instrument can readily occur.

If these instruments are made of bakelite they do not slide in the urethra as readily as nicked instruments and once the lubricant has become dried as a result of repeated heating from the high frequency current are a potential source of urethral trauma. Because the instruments are of large caliber care should be exercised to see that the urethra is adequately dilated by the passage of sounds before their insertion.

Failure to observe these precautions will result in periurethral abscesses, fistulae and strictures. To relieve the patient of a urinary obstruction due to prostatic hypertrophy and as a result leave him with obstruction due to urethral stricture is inexcusable but requires care to be avoided.

The removal of large amounts of tissue not only prolongs the opera-

tion but leaves a large area of raw surface from which toxic absorption may readily take place

Secondary infection readily develops under such circumstances, for the presence of large amounts of tissue either devitalized or rendered less resistant by excessive coagulation affords an ideal culture medium

The prolongation of the operation also results in more loss of blood and the larger denuded surface produced is more prone to secondary hemorrhage than a small area would be

While in most cases the choice of resecting all the tissue at one operation or at several is open to the operator, in some of the huge adenomatous hypertrophies it becomes a matter of necessity for, although several operators have reported removing over 50 grams at a single sitting, the mere fact of their report indicates the amounts were exceptional (Fig 468) For the average operation, the removal of

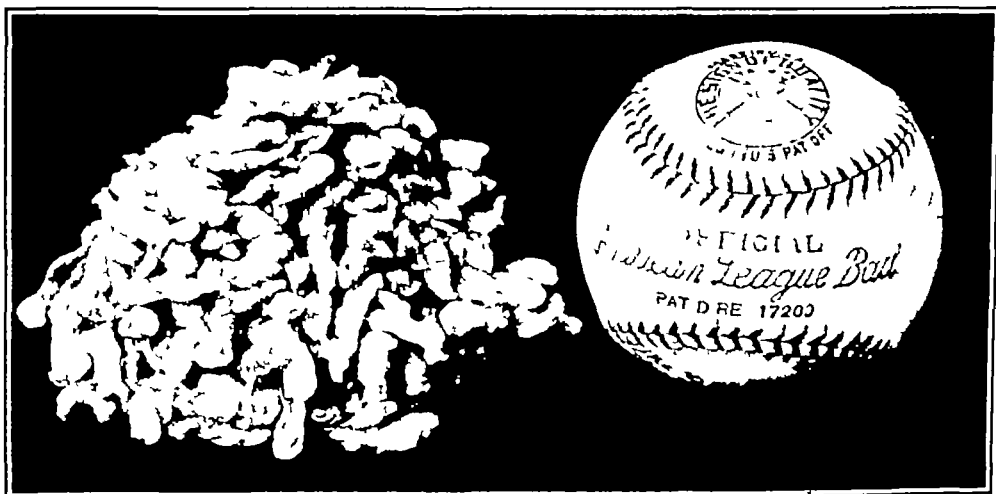


FIG 468 —Tissue weighing 110 grams removed with the Bumpus punch from a single patient. Note the clean cut regular edges of the individual pieces, the result of razor-edge sharpness of the cutting tubular knife, an essential for success by this method of excision

from 20 to 25 grams at one time will prove sufficient. With the method used at the Mayo Clinic 89 per cent of the 451 cases operated in 1933 were done at one operation

Because the operation is usually performed under a regional anesthetic, it is preferable to do it in multiple stages if the entire obstruction cannot be resected in the neighborhood of an hour. This insures ample anesthesia throughout the procedure and a minimum of trauma from instrumental manipulation. Less than an hour was required for resection in 90 per cent of the cases in the Mayo Clinic series just referred to

The ease of the procedure when compared to prostatectomy and its freedom from serious reaction also favors its repetition whenever occasion demands (Fig 469). Subsequent operations are always easier both for the patient and from the technical standpoint. The

greater room provided as a result of the previously removed tissue makes instrumental manipulation easier. The remaining tissue has in the interim between operations become sufficiently edematous to frequently place it in a more advantageous position for resection than it formerly was thus adding still further to the ease of the procedure.

There is also the not infrequent case which derives such a satisfactory functional result from the first operation that the second is not required and certainly the risk incurred by leaving more tissue surrounding the urethra at the end of the operation is considerably less.

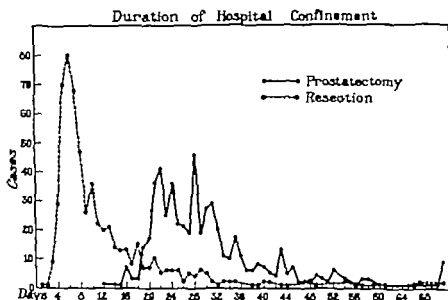


FIG. 409.—A comparison of the hospital stay of 600 patients having undergone a prostatectomy with an equal number who had resection.

Time Interval.—There can be no set rule as to the interval between operations as each patient presents individual problems. However it is seldom that the urethral irritation from instrumentation has subsided sufficiently to permit of the passage of instruments in less than seven days and usually ten days are required. Such multiple operations of course extend appreciably the hospital stay of the patient and in the larger glands this may in the aggregate exceed the time usually consumed in the convalescence from a prostatectomy but there seems little question but what the added time is justified in view of the much lower mortality of the transurethral procedure.

In 1933 there were 451 cases resected at the Mayo Clinic with 5 deaths 1.11 per cent while in 1934 a consecutive series of 322 cases was operated before the next death occurred. Alcock reports 2 deaths in his last 275 cases while Davis had 2 patients both of whom had left the hospital die within thirty days in a series of 323 cases.

When multiple operations are done the residual urine must be cared for either by an indwelling urethral catheter or by frequent catheterization for its presence in association with a traumatized bladder neck is a fertile field for serious secondary infection. If the bladder is fre-

quently irrigated during the interval between operations the possibility of such a complication is slight. If the patient is extremely debilitated, especially if the renal function is poor, it is advisable to precede the transurethral resection by suprapubic drainage.

Shrinkage as a Result of Resection.—As two-stage prostatectomy became popular, it was noted that after suprapubic drainage the prostate gland usually decreased in size, occasionally to an unbelievable degree. Caulk early recognized that the same diminution in size followed partial removal of the gland by resection and he writes: "To my mind this is the most significant single phase of the entire subject. I have for ten years carefully studied the transformation and transition both by careful rectal and cystoscopic study of a large number of prostates under drainage and partial removal and with but few exceptions observed that the gland presented a most striking tendency to diminish in size and undergo retrogression under these conditions. This particular feature of the subject, the importance of which I have been stressing for many years, is the basis of my belief in the rational application of minor surgery for large prostatic obstructions. This evidence of uniform shrinkage following drainage and particularly after partial excision of tissue offers highly suggestive evidence that these growths are fundamentally inflammatory because no other would show this tendency to retrogression," an observation that has influenced him to favor multiple operations.

BLEEDING IN TRANSURETHRAL RESECTION.

The control of bleeding was without doubt the main factor which delayed the development of transurethral resection. It still remains an occasional annoyance at operation and a trying complication during convalescence but no longer a serious menace except to the inexperienced.

Bleeding at Operation—The blood supply of the prostatic urethra consists of a plexus of arterial vessels traversing the mucous membrane connected by radial feeders that connect with a second plexus in the periphery of the gland.

More bleeding occurs, therefore, following the initial incisions than takes place once the mucous membrane is all removed and the cuts are made in the adenomatous tissue itself. Here the vessels are larger and can be seen as individual spurters. As the periphery of the gland is reached a second plexus of vessels is encountered and bleeding again becomes diffuse and so more difficult to control.

With those instruments which employ the wire loop for excision, most of the venous bleeding and some of the arterial bleeding is controlled by the coagulating power of the current as the tissue is excised.

A similar degree of hemostasis is produced by the cautery punch and by the needle electrode thrust into the tissue before its excision. None of the instruments produce complete hemostasis at the time of excision and it is necessary to go back over the cut surface and by mild coagula-

tion seal the larger bleeders. Some operators prefer to excise several pieces of tissue before doing this while others advise that all bleeding be cared for as it occurs. Because a lens system of visualization demands clear irrigating fluid for proper observation the number of pieces of tissue which one may excise without stopping to control the bleeding is self limited. With a direct vision instrument bleeding interferes but slightly with vision and can be disregarded as long as the operator desires provided he does not allow clots to form.

The formation of clots is a serious complication no matter what instrument is being used and should be avoided as far as possible for by obstructing vision they make it impossible to locate the bleeding points and coagulate them. To prevent their formation the irrigating fluid should be copious and always flowing rapidly and the fluid in the bladder frequently emptied. If clots do occur they are best removed



FIG. 40.—Blood supply of the posterior urethra showing the radiating vessels going to the external plexus.

by suction either with a Bigelow evacuator such as is used to remove stone fragments or by a large syringe attached directly to the end of the resectoscope. The latter method exerts more suction than can be obtained with the bulb of the Bigelow evacuator. Some operators prefer a hoe-like wire instrument which pulls the clots into the barrel of the instrument depending on intravesical pressure to help force them out. If spinal anesthesia is used such pressure is of course lacking.

As experience with resection is developed the added speed one acquires practically obliterates the complication of clot formation and only the matter of controlling the larger spurters demands consideration.

The amount of bleeding during operation varies tremendously with the type of case. Patients who have considerable inflammation in the prostate associated with the obstruction are naturally prone to bleed

freely. If such infection is excessive a course of massage prior to resection will be found to reduce the bleeding incident to the resection appreciably and also shorten the convalescence. If the obstruction has been of recent origin and there is much congestion in the gland bleeding will be excessive. A few days of catheter drainage will reduce the amount of bleeding encountered at operation. The blood-vessels in the benign adenomatous hypertrophy while larger in caliber are more discrete, easily located and readily coagulated.

In malignant disease the bleeding is apt to be rather profuse but as too extensive electrocoagulation need not be feared is not difficult to control.

When blood-pressure has dropped, either as a result of spinal anesthesia, or from too great a prolongation of the operation, the amount of bleeding at the operative site markedly diminishes and at times ceases entirely. This makes the rapid excision of tissue feasible but prevents the exact control of the bleeding vessels by electro-coagulation. Such uncoagulated vessels are very apt to commence bleeding when the patient has been returned to bed and the blood-pressure returns to normal.

The occurrence of postoperative bleeding following a drop in blood-pressure at time of operation occurs so frequently with spinal anesthesia that some surgeons refuse to use it, preferring a general anesthetic that keeps up a maximum of pressure throughout the operation and hence lessens the chances for postoperative bleeding. Spinal anesthesia also has the disadvantage of paralyzing the bladder so that the patient does not complain of overdistention. Trauma from this source may be serious if the irrigating fluid is allowed to flow too long at too great a pressure, producing mucosal tears and even bladder rupture.

Postoperative Bleeding. Bleeding which occurs during the first forty-eight hours after the operation is seldom of itself a serious complication were it not for the formation of clots. If the catheter is watched carefully and irrigated sufficiently often to prevent their formation the bleeding usually stops gradually. *An empty contracted bladder is the best insurance against hemorrhage.* If the catheter has not been kept open a small clot may obstruct it and as the bladder fills it contracts in an ineffectual attempt to expel its contents. Failing in this, more contractions occur until spasms develop and the bleeding which was insignificant to start with is aggravated, more clots form which the bladder tries vainly to expel, and so a vicious circle is established. There is nothing to be gained by watchful waiting in the hope that the bleeding will stop. It will not! It will continue until the bladder has been cleared of clots. When this has been accomplished, it is often difficult and frequently impossible to find the original bleeding point. If it is found, it should be lightly coagulated, an indwelling catheter placed in the bladder and the patient returned to bed.

In a series of 488 cases reported by the author in 1933 it had been necessary to transfer only 14 patients (3 per cent) to the operating room in order to locate, coagulate and evacuate the clots.

Bleeding occurring later in convalescence that is after the first forty-eight hours may on occasions assume the proportions of post operative hemorrhage if clots obstruct the urethra but usually it is of much milder degree and can be cared for by irrigation of the bladder through a catheter and putting the patient at rest.

Such late bleeding is the result of the sloughs of coagulated tissue tearing away and is most apt to take place from ten days to three weeks after operation. It occurs in direct ratio to the amount of high frequency current that has been required to excise the tissue and control the bleeding by coagulation at time of operation. It is the chief deterrent to excessive electro-coagulation.

If clots occur and are promptly evacuated the bleeding usually stops spontaneously. The overzealous in an endeavor to establish drainage through an obstructed catheter have been known to keep forcing in irrigating fluid with the forlorn hope that the next syringe full would start the outflow of urine until the bladder was finally ruptured.

If large caliber instruments or catheters are not available through which to evacuate the clots either by suction or with a wire clot extractor it is preferable to do a suprapubic drainage. To continue to force irrigating fluid into an already overdistended bladder cannot be too strongly condemned.

The use of various styptic drugs and biological products either locally or systematically is of little value. *To stop bleeding all clots must be evacuated and the bladder kept empty*—only then will drug therapy be of any avail.

Coagulation.—Hemostasis during resection is dependent upon coagulation in some form. If it has been too extensive convalescence is sure to be prolonged and may be complicated by either sepsis or bleeding for all tissue that is destroyed by coagulation and not excised must be gradually dissolved in the urine or else slough away. If it sloughs away it may open up new channels of bleeding. If it remains to be dissolved it is a fertile focus for continued urinary infection.

The high-frequency current, either damped or undamped is a form of diathermy. If the electrodes were of equal size the tissues between would heat up gradually throughout their volume. But one electrode being a plate and the other a loop or point the point of greatest heat is closest to the smaller electrode as the current concentrates there from the larger field of the plate. On the amount of current passing and the length of time of its flow depends the amount of heat generated in the neighborhood of the smaller electrode. If this is excessive either in amount or duration tissue is going to be destroyed by coagulation not only at the site of the smaller electrode but for a considerable distance beyond depending on how high the temperature has risen as a result of the passage of the current through the limited area about the smaller electrode. Belt has demonstrated this in the prostates of dogs and concludes: A coagulating current of low voltage when held in contact with the surface of the prostatic urethra for a length of time sufficient to whiten the tissue causes cell death to great depth.

The depth of the subsequent slough bears a direct relationship to the length of time the active electrode is in contact with the tissues "

Caulk has measured the temperature of the heated tissue by thermocouples and demonstrated that the coagulation of the actual cautery is less penetrating than that produced by a high-frequency current. Those using a tubular knife to excise the tissue and depending upon electro-coagulation only to control the bleeding believe they attain a maximum of hemostasis with a minimum of coagulation and tissue destruction. It would appear beyond question that the least coagulation should be followed by the more rapid and uncomplicated convalescence provided infection has not been a complicating factor.

INFECTION IN TRANSURETHRAL RESECTION.

When tissue is traumatized as well as destroyed by electro-coagulation there is developed an ideal culture media for bacteria. If this condition is brought about in a closed viscus such as the bladder and in the presence of residual urine its occurrence is unavoidable except by the most rigid aseptic technique before, during and after resection. If the operative field is kept sterile, severe postoperative febrile reactions will not occur but if secondary infection is permitted then elevated temperatures, chills and fever are the order of the day.

To prevent such distressing sequelæ of resection all patients' urine should be cultured when first examined and subsequent cultures made just prior to operation, a few days after operation and at dismissal. If this procedure is followed it will be noted that where the culture have remained sterile throughout the series or where the bacterial flora has remained unchanged febrile reactions after operation are negligible but in cases where bacteria foreign to the host appear, febrile reactions are prone to take place and even if they are absent convalescence is apt to be prolonged and dysuria frequent.

Familiarity breeds contempt and because urologists have in the past carried out transurethral manipulative procedures with indifferent aseptic technique there is a tendency to be equally slovenly in the case of resection.

It has been proved by clinical experience and experimental investigation that a urinary tract that is unobstructed and not traumatized is difficult if not impossible to infect. In the case of resection, the urinary tract is obstructed and traumatization is a necessity of the procedure so that the field is all set for secondary infection.

Because it requires large amounts of fluid to do a resection, its sterilization may be indifferently cared for or if it is kept in a large reservoir the sterilization of the container may be difficult. The irrigating fluid must be sterile and should be checked by culture. It is surprising how rapidly bacteria will multiply in the stagnant fluid of a supply pipe from reservoir or irrigating tank.

During the operation the aseptic technique of any surgical procedure is followed but after the operation the great possibility of secondary

infection occurs. A catheter is placed in the urethra at operation. This should be wrapped in a sterile towel or preferably the end placed in a sterile test tube or bottle before being wrapped in the towel. It is through the distal end of this catheter that secondary infection is going to reach the operative site. *It must be constantly and scrupulously guarded against contamination.* To simply place it in a urinal once the patient has returned to bed is to render useless all the aseptic technique of operation. Such urinals are teeming with bacteria or will be within a very short time of their receiving the blood and serum laden urine that drips from the catheter. Infection rapidly travels up a urethral catheter and the following day a rise of temperature or chill proclaims its arrival at the operative field and into the general circulation.



FIG. 471.—Lavage of the bladder under rigid aseptic technique. Syringe catheter, bottle of irrigating solution and basin are put up in individual sterile packages. Tube from catheter to bladder is never disconnected except under aseptic precautions.

Immediately the patient is placed in bed the nurse opens the sterile towel and with sterile gloves and syringe irrigates the catheter to be sure it is not obstructed by clots after which it is connected to a sterile tube some 3 or 4 feet in length that leads to a sterile bottle (Fig. 471). This connection is never broken until the catheter has been placed on a sterile towel and the end washed with some germicide. The bottles should not be emptied for in that case the end of the drainage tube may be allowed to come in contact with the floor, sheet, mattress or other contaminated surface. When the bottle is full the nurse exchanges it for one that has been sterilized. If the patient wishes to get out of bed he carries the bottle and tubing with him. Usually this is not necessary for at the end of forty-eight hours the catheter has been removed.

To permit the end of the catheter to come in contact with the bed linen is apt to mean the direct conveyance of organisms from the

rectum to the prostatic urethra. If the catheter is kept continuously connected with the tubing this cannot occur. If the technique described is adhered to the incidence of postoperative febrile reactions will be astoundingly few and a temperature of over 101°F rarely seen at any time during convalescence.

The use of germicides such as methenamine, either orally or intravenously, should, I believe, be reserved for cases where infection has occurred. Their routine administration as a matter of prophylaxis is not justified and gives a sense of false security to those responsible for the patient's care.

POSTOPERATIVE CARE IN TRANSURETHRAL RESECTION.

At the conclusion of the operation a catheter is passed and tied in the urethra. This should be soft and pliable as one made of too dense rubber traumatizes the denuded surfaces and may produce secondary bleeding. The catheter should not be of too large caliber for the same reason and to permit the easy drainage of the urethral secretions along its surface toward the meatus.

Upon the patient's return to bed the catheter should be under constant observation to insure its constant drainage. If this is interrupted, immediate irrigation under the aseptic precautions previously mentioned is carried out. Some operators make it a routine practice to have the catheter irrigated every ten minutes for the first three hours after operation and every half hour for the next twelve. Whatever practice is followed the essentials are to insure an empty bladder at all times without the introduction of infection.

As continuous and rapid urinary secretion is desirable the fluid intake should be supplemented by the administration of normal salt solution immediately after operation either by vein or subcutaneously. The administration of fluid by these methods should be continued until the patient's urinary output exceeds 2000 cc daily.

When gross evidence of bleeding has disappeared the urethral catheter can be removed, usually at the end of forty-eight hours. The patient is then cautioned about straining at urination and instructed to relax while voiding and to keep the sphincter relaxed, especially immediately after voiding. The desire to strain and force out the last few drops is frequently the cause of terminal hematuria and can be prevented by proper instruction at this time. If the patient cannot void without straining, the catheter should be reinserted and a day or two allowed to elapse before its second removal. If he voids without difficulty or discomfort, it only remains to determine if he completely empties his bladder. If more than 30 cc of residual urine is present, then it is best to catheterize the patient daily and irrigate the bladder with warm boric acid solution until the residual disappears. If no residual is present, lavage is seldom necessary and postoperative care consists in forcing of fluids and the sterilization of the urine by oral medication or diet.

The work of Clark and of Helmholtz has shown that with the increase in acidity of the urine the growth of the more common of the bacteria infecting the urinary tract is inhibited. If such organisms as the colon bacilli (*Escherichia coli* *aërogenes* and *aerobacter aërogenes*) are the etiological factors the reduction in the pH of the urine by the administration of ammonium nitrate or ammonium chloride will aid in increasing the acidity of the urine and inhibit their growth. If in addition methenamine is administered either orally or by intravenous injection all but the more resistant infections will usually clear up. For these the placing of the patient on a ketogenic diet with the resulting liberation in the urine of Beta-hydroxybutyric acid has proved the most efficacious method of treatment. Such a diet is difficult to take over any prolonged period of time and unless it can be supervised by a dietitian often proves disappointing in its results but when accurately supervised proves more efficient than any of our present forms of medication.

IMPAIRED RISKS IN TRANSURETHRAL RESECTION

Because transurethral resection carries less risk many patients are subjected to this procedure who because of severe cardiac lesions or greatly impaired renal function would not be considered suitable risks for prostatectomy by the most optimistic surgeon. In such cases, if the amount of obstructing tissue is great multiple resections are indicated for under proper postoperative care there is little reaction if the operation has not been prolonged. In the exceptionally bad risks a previous suprapubic cystostomy may be deemed advisable but it should be remembered before advising it that the mortality rate from cystostomy in any large series of cases is higher than that following an equal number of cases of resection in experienced hands.

Thompson at the Mayo Clinic in order to have available some evidence of the relative safety of the transurethral operation reviewed the last 25 cases in which it was performed on patients who were more than seventy years of age and compared these cases with the last 25 cases in which patients of similar age were submitted to prostatectomy. The former all survived. Of those who underwent prostatectomy 4 died. As he points out many of the patients in the former group were refused a major operation while all of those upon whom a prostatectomy was performed had apparently a good chance for recovery or the operation would not have been advised. There is not the least doubt that the patients who constituted the poorest risks were cared for by transurethral resection.

Alcock in comparing 400 consecutive prostatectomies that he had performed with an equal number of resections found the average age of the prostatectomies to be 68.3 years while that of the resection cases was 72.1. He believes that 20 per cent of the cases he now resects are such bad risks that he never would have attempted a prostatectomy.

That resection is a safer operation for these more debilitated patients

none question This being true, it is difficult to understand why it is not also a safer procedure for the less debilitated, a fact that not all are ready to admit

THE VARIOUS INSTRUMENTS FOR TRANSURETHRAL RESECTION.

Attempts to remove obstruction at the neck of the bladder by means of instruments introduced and operated through the urethra have been made since ancient times but until the various types of obstruction had become identified as a result of scientific study no satisfactory method for their removal could be expected The first treatise on the subject was by Everard Home in 1806, who wrote, "An Account of a Small Lobe of the Human Prostate Gland which has not before been taken notice of by anatomists" This was followed in 1825 by Howship's paper "On the complaints that Affect the Secretion and Excretion of Urine" in which he described a curious and rare affection of the internal membrane forming a transverse fold or valve at the neck of the bladder

Following these papers Guthrie in 1830 described a non-prostatic obstruction under the title "The Bar at the Neck of the Bladder," first calling attention to the difference between hypertrophy of the glandular tissue of the prostate and the various contractures of the vesical orifice which he referred to as elastic structures At this early date he advised that transurethral methods of treatment be confined to this type of obstruction, a dictum that was destined to be considered as sound advice for nearly a century

Guthrie's Knife —At the suggestion of Guthrie, Everill and Mason designed an instrument for cutting the elastic bands he described It consisted of a concealed knife in a metal tube curved like sound, from the extremity of which the small concealed knife could be projected from the end or side The instrument was intended for incision only, no attempt being made to remove tissue

Mercier's Prostatome —The first instrument intended to excise obstructing tissue was devised by Mercier, who in addition to designing several instruments for incision developed one that was capable of removing small bits of tissue As no provision was made for either vision or the control of bleeding, the applicability of the instrument was very limited and the instrument found little use except by the inventor.

Bottini Galvano-cautery —During the middle of the nineteenth century the practical application of electrical currents was progressing rapidly and in 1874 Bottini devised an instrument for the incision of obstructions of the vesical neck (Fig 472) It resembled a lithotrite, the male blade of which acquired a red heat by the passage of a galvanic current and hence by searing the tissues was intended to avoid the hemorrhage which was so dangerous a complication of the previous methods This instrument (Fig 473) met with considerable favor, was extensively tried, considerably modified by Wassidlo and later by

Freudenberg (Fig. 474) and others and in the end greatly improved. This remained the method of choice for transurethral corrections of obstructions to the bladder outlet until the technique of perineal and suprapubic prostatectomy were introduced. Then it was demon-

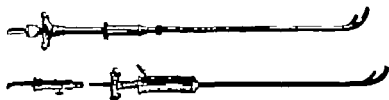


FIG. 472.—Bottini's galvano cautery.

strated that the operation of complete removal of the enlarged portions of the prostate was just as safe as its extensive cautery destruction and the results more satisfactory and permanent. As a result attempts at transurethral correction of obstruction were temporarily abandoned.

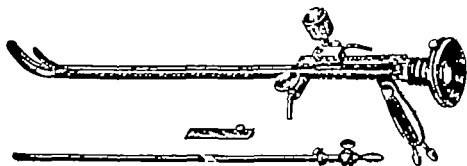


FIG. 473.—Wassilio's modification of the Bottini galvano cautery. The first instrument for the correction under vision of vesical-neck obstruction.

Luxé Forage de la Prostate—The utilization of the galvanocautery current first tried by Bottini for the destruction of prostate tissue had many subsequent advocates. Among these was Wishard of Indian

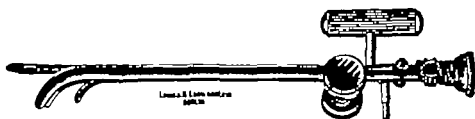


FIG. 474.—Freudenberg's modification of Wassilio's instrument. The lens is brought out beyond the blades so that vision is not shut off when the jaws engage.

apolis who, using a head mirror and a speculum, cauterized the vesical neck through a perineal incision. He later designed an air dilated cystoscopic equipment for use instead of the head mirror and speculum and reported treating 4 cases with it by destruction with the galvanic

cautery Goldschmidt subsequently improved the accessibility of the posterior urethra by perfecting the first urethroscope, making it possible to examine the structures about the verumontanum through an irrigating fluid. What Nitze had done for visualization of the bladder Goldschmidt did for the urethra. Included in Goldschmidt's instrument was a needle for the cauterization of obstructing tissue with the galvanic current.

Stimulated by these advances Luys developed his operation of forage or tunnelling of the prostate gland, which was carried on through an endoscope with an electric light (Fig 475). The procedure consisted of destroying the obstructing portions of the gland by electro-coagulation and was done in a dry field. The operation was never completed at one time and the multiple treatments frequently consumed several months, a factor which mitigated against its general adoption.

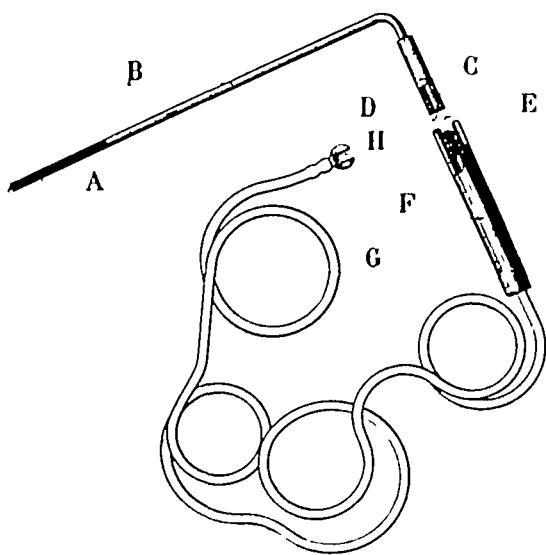


FIG 475 —Electrode used by Luys through an endoscope for doing his forage of the prostate

Young's Punch.—Believing that the amount of tissue removed at many operations is often so small that it seems ridiculous to have to perform a major operation in order to excise the few grams of tissue that happen to encroach upon the urethral lumen, Young in 1909 devised an instrument which acquired the name Punch because of the thrust used in its manipulation (Fig 476). In principle, although not in design, it resembled the prostatome of Mercier and in applicability had much the same limitations. For, although it had a light holder

and attempts were made to remove the median bar or other structures at the vesical neck under visual direction, experience showed that while it was possible to see the tissue which was entrapped in the fenestrum of the instrument and to observe the first cut, hemorrhage which followed effectually prevented observation of the succeeding cuts. Subsequent experience demonstrating that the operation could be very efficiently and accurately performed without visual direction the light carrier was abandoned.

This instrument became the accepted means of correcting contractions of the bladder neck and other types of lesser obstruction to the outlet of the bladder. No provision for hemostasis being provided, the amount of tissue capable of removal was necessarily limited but the correction of obstruction due to adenofibromatous hypertrophy was never intended and in fact was warned against by Young, who

always insisted that the procedure should be reserved for fibrous constrictures of the vesical orifice bars or small subcervical glandular enlargements

Technique of the Punch Operation — After the application of some form of regional anesthesia fortified by a $\frac{1}{4}$ grain of morphine hypodermically the bladder is filled with fluid and the instrument inserted. It is carried well into the bladder and the obturator quickly withdrawn thus uncovering the fenestrum and allowing the fluid to escape through it from the bladder. The instrument is then rapidly drawn outward and as the fenestrum comes into the urethra the obstructing portion

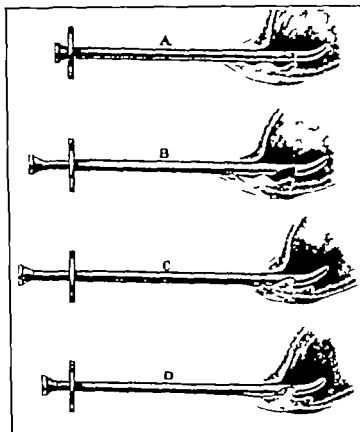


FIG. 45 — Steps in technique of Young's punch operation.

of the vesical neck dips into it and stops the outflow of fluid indicating that the instrument is in proper position. The operator then simply pushes home (punches) the sharp tubular knife that forms the inner sheath of the instrument thus excising that portion of the obstructing tissue which is within the instrument. If the tissue excised has not stuck inside of the tubular knife it is withdrawn from the interior of the instrument with alligator forceps. As a rule more than one cut is made and the operator turns the instrument in the desired direction and repeats the procedure described.

Bleeding usually being in proportion to the number of cuts made

the procedure becomes self-limited and the operator turns his attention from the removal of tissue to the control of the hemorrhage he has produced. If this is not too excessive, the installation of a No 28 or No 30 French catheter in the urethra and the constant irrigation of the bladder with evacuation of the clots may suffice for its control. More radical measures have on occasions been required and for this reason the procedure never became popular even for the limited field in which it was advised and for more extensive removal of tissue it was inadequate both because of the bleeding produced and of the sparsity of vision during operation.

Braasch's Median Bar Excisor.—To overcome the inadequacy of vision in an instrument with a closed end Braasch had his direct cystoscope modified by undercutting the distal end and inserting an inner sheath with teeth to grasp the obstruction (Fig 477). The tubular knife was similar to Young's but smaller in diameter as it was contained within the extra sheath. This decrease in the diameter of the knife, while it made the amount of tissue removed at each bite small, was not a serious handicap for, as no means of hemostasis was provided, large amounts of tissue could not be removed and in fact the name of the instrument implies it was for use only in bar formations and lesser degrees of contracture.

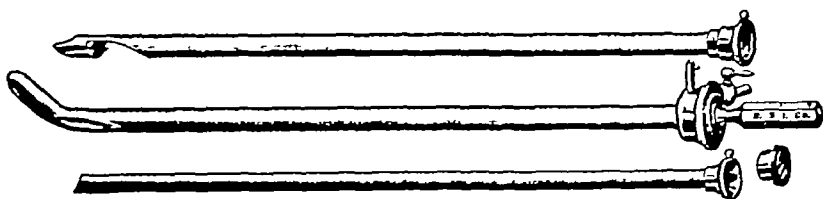


FIG 477 —Braasch median bar excisor, showing toothed inner sheath for grasping the obstructing tissue, also tubular knife for excising (Courtesy of Electro Surg Inst Co)

The ability to see not only the tissue as one cuts as it projected into the fenestrum but its relationship to all other structures in the posterior urethra and at neck of the bladder was a decided advantage but as few urologists use the direct cystoscope and no means of controlling bleeding was provided the instrument did not come into general use.

The ability to correct urethral obstruction due to any but the minor degrees of hypertrophy and contractures of the vesical neck by trans-urethral methods made little progress in nearly a century, due chiefly to the inability to satisfactorily control bleeding and at the same time remove an appreciable amount of tissue.

With the presentation by Caulk in 1920 of his cautery punch this problem commenced to be solved (Fig 478).

Caulk's Cautery Punch —It is a matter of record that Young in 1911 had Loewenstein in Berlin construct a cautery blade for his instrument with a water-cooled sheath but the punch procedure had such a limited field and Young was obtaining such excellent results with the perfection of his perineal technique that the new instrument excited but little enthusiasm even in its originator and was entirely ignored by others.

Bottini had utilized the cautery principle to control bleeding, but had failed to remove the obstruction in most cases because no attempt at excision of tissue was made. When the idea of combining the excision of the obstruction with the control of bleeding by cautery was achieved by the genius of Caulk a decided step had been taken in the right direction. It had been long appreciated that frequently a very small portion of the total enlarged gland was the cause of the difficulty and to remove benign enlargement simply because an insignificant portion of it might be obstructing the lumen of the urethra which is barely a centimeter in its greatest diameter was to say the least highly illogical and occurring as it so frequently did in patients of advanced age and great debility frankly dangerous.



FIG. 478 —Caulk's cautery punch

Construction of the Instrument —The instrument in design was a duplication of Young's original punch except that in place of the tubular knife Phillips constructed for Caulk an inner sheath which has at its terminus an iridioplatinum blade instead of a knife. This blade is about $\frac{1}{4}$ inch in width and of substantial thickness. It is insulated from the main sheath of the instrument by mica plates. The instrument is so devised as not to require an irrigating system to cool the shaft. This makes it possible to have the diameter of the cutting knife and the fenestrum of a maximum size and so remove ample sized pieces of tissue at each bite of the instrument. As Caulk explains

In order to burn tissue properly and prevent hemorrhage the procedure must be done slowly under low heat. Otherwise the process is about the same as with a cold knife. To do this we must be able to produce enough heat in the blade to burn the tissue without heating the shaft of the instrument. For this reason the conductors have been made large and of uniform caliber throughout so that they offer the minimum resistance to the current which is thus brought directly to the only point of increased resistance the cautery blade. In this way an intense

heat may be maintained for a sufficient period of time without heating the instrument "

Although this instrument did much to control the distressing complication of bleeding it had the same handicaps as respected vision during the operation as the original Young instrument and with the ability to remove larger amounts of tissue due to the hemostatic factor this handicap became more serious

Fourteen years after its first presentation Caulk writes, "It is still our belief that the original cautery punch offers the quickest, safest and most effective method of removing prostatic obstruction. The vision obtained by reflected light reveals the natural orifice and affords an unmistakable picture. For some reason operators have felt a timidity in relying on this type of vision but this is due entirely to inexperience, most of the ideas have been purely impressionable rather than actual "

In order to satisfy the demand for cystoscopic visualization and irrigation he had Cacklev modify the instrument. It now embodies a platinum-iridium knife in the form of three-fourths of a circle connected to metal electrodes. The absence of a complete circle allows the knife to slide over a McCarthy Foroblique telescope and light with which it has been equipped and gives vision of the movement of the knife during the entire cut. The electric current has been so modified by lowering the voltage and raising the amperage that the platinum blade is said to cut under water with a cautery current quickly and cleanly. The instrument is also equipped with an electrode which may be pushed forward and brought against any bleeder for purpose of coagulation but the to-and-fro movement of the cautery blade over the site of hemorrhage usually suffices for its control.

Braasch-Bumpus Punch —The use of heat as a hemostatic agent in the original Caulk punch operation necessitated carrying on the procedure in a dry field with the bladder empty. This markedly limited the possibilities of the operation already handicapped by lack of adequate vision afforded by this instrument. For although it was true that one could see the tissue to be excised after it had been grasped it could not be seen before it was grasped and its relationship to other structures could not be determined. However, after the initial incision serum, eschar and blood make all tissue presenting through the fenestra look very much alike. The author, therefore, modified the Braasch cystoscope by placing in the shaft a fenestrum equal in size and of the same shape as that in Caulk's punch, (Fig 479a) using a tubular knife in place of the cautery (Fig 479c). The bleeding was controlled when it became excessive by coagulating the cut surface with a flexible electrode (Fig 479d). Later, at the suggestion of Tyvand, the base of the tissue to be excised was coagulated with a multiple needle electrode before excision. (Fig 479b).

The needles in this electrode are placed in the same circumference as the tubular knife blade and thus render relatively bloodless the path through the tissue that the blade is to follow. This principle of

tissue desiccation by needles prior to excision was not original but had been employed by both Day and Kurwin in their instruments but as employed in this instrument it is more limited in extent and is not intended to extend beyond the thickness of the knife blade. It does not coagulate the pieces of tissue sufficiently to in any way interfere with their microscopic examination.

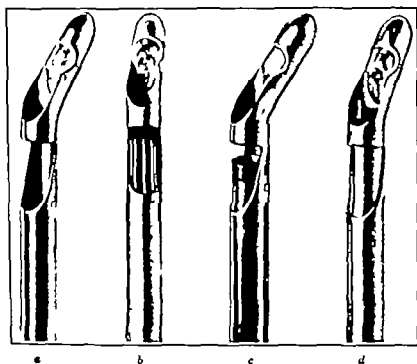


FIG. 479.—The Bumpus modification of the Brannan cystoscope for removal of tissue at the bladder neck. (a) Fenestrum for engaging tissue. (b) Multiple needle electrode. (c) Tubular knife. (d) Conversion of the instrument to a cystoscope by closure of the fenestra by an inner sheath, with a flexible electrode passed through the inner sheath for coagulation of the individual bleeding points.

Technique of Operation—For those who are familiar with the use of the direct cystoscope or if not are willing to learn the simple technique the removal of the obstructing tissue with a tubular knife affords a simple and rapid procedure (Fig. 480).

The urethra being well dilated and lubricated the instrument is passed and after the obturator is withdrawn the observation window which carries with it a short tubular sheath for closing the fenestrum is passed converting the instrument into a direct cystoscope. The prostatic urethra from the verumontanum to the trigone is carefully examined to determine what portions of the enlarged lobes of the prostate gland are obstructing the urethra and what is their relationship to other structures. When this examination is completed the sheath which closes the fenestrum is withdrawn and the observation window alone is replaced. Then under full vision the portions of the obstructing tissue are forced into the lumen of the sheath through the fenestrum (Fig. 481). When the obstructing tissue has thus been firmly grasped

the observation window is removed and into the projecting tissue is thrust the multiple needle electrode. The high-frequency current from a plate generator (damped current) is then allowed to flow long enough

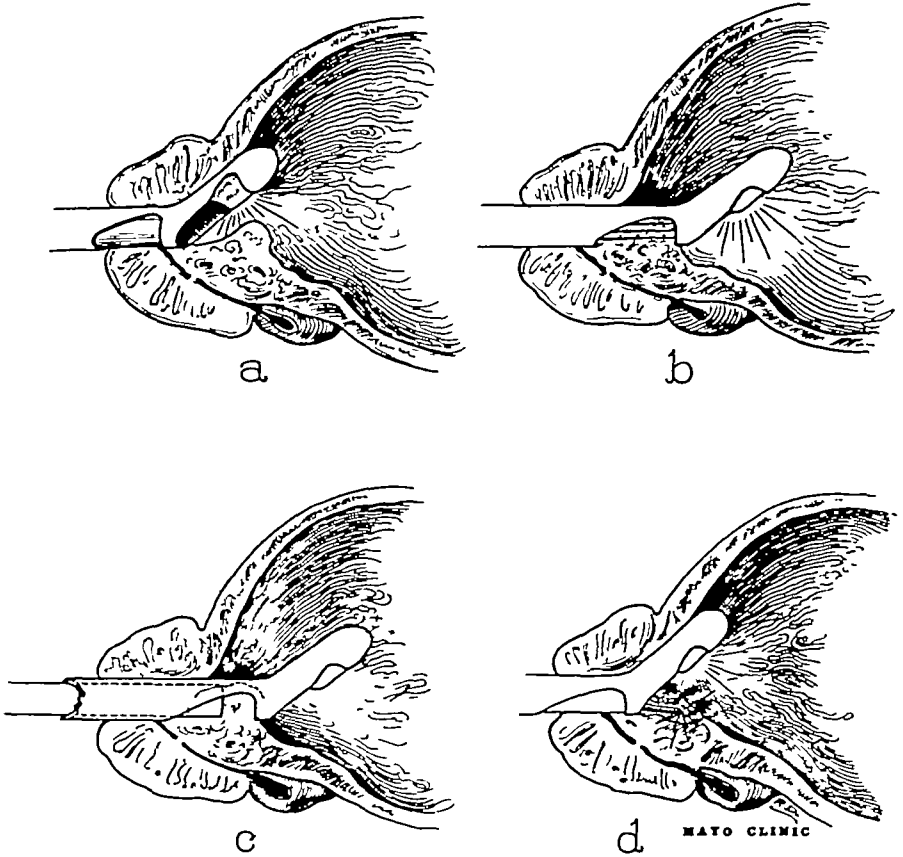


FIG 480 —Steps in the excision of obstructing tissue when using the Bumpus instrument (a) Observation of the bladder neck (b) Insertion of the multiple needle electrode (c) Excision of the tissue (d) Control of individual bleeders with the single flexible electrode

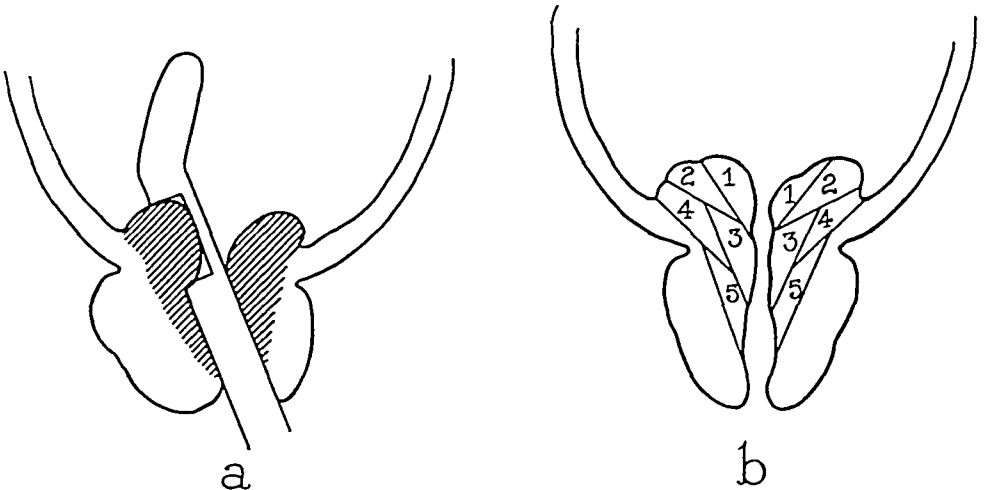


FIG 481 —Order in which portions of the obstructing tissue must be excised when using a punch instrument in order to insure a constant edge upon which the fenestrum can be caught

to electrocoagulate the course that the tubular knife is to follow. The object is not to desiccate completely the tissue that is to be excised but simply to render ischemic the course of the knife and so diminish bleeding. When this has been done which requires about ten seconds the needle electrode is withdrawn and the obstructing tissue is excised with the tubular knife.

If some bleeding follows this excision the guide for use with the single flexible electrode is placed in position the bleeding vessels are electrocoagulated individually after which the procedure is repeated.

In the usual case operation requires less than one hour. Thompson in reporting the Mayo Clinic cases operated by himself Priestley and the author found but 20 per cent took longer.

TIME OF OPERATION

	Cases	Per cent
Thirty minutes or less	77	31.18
Thirty-one to fifty nine minutes	715	48.76
One to two hours	146	20.06

In some very large glands it is impossible to remove all of the tissue at a single sitting in which case the operation must be repeated after the lapse of from a week to ten days. There is no difficulty however in removing up to 30 grams of tissue by this method at a single operation and by the experienced considerably larger amounts have been resected.

The amount of bleeding encountered when using this instrument varies greatly with the different types of tissue removed. In benign adenomatous hypertrophy bleeding is easily controlled for the individual vessels are readily discernible once the plexus immediately beneath the mucosa is passed. When there is an associated inflammatory condition the bleeding is naturally much more profuse. Care must be exercised to see that the tubular knife is very sharp like a razor blade and several should be kept on hand and resharpened after each resection for a dull knife will tend to push the tissue out of the fenestrum instead of cutting it and smaller pieces will be obtained at each incision. Also a dull knife tends to tear mucosa and torn mucosa is notorious for its profuse bleeding which is most difficult to control while a clean cut edge gives little trouble for the individual vessels can be seen spurting and a single application of the electrode tip usually suffices for their control.

During the operation with this instrument there is considerable more bleeding permissible than by other procedures for as vision is not dependent upon a lens system bleeding that does not result in clot formation is entirely ignored. Toward the end of the operation the needle electrode is dispensed with, the operator endeavoring by this means to cut away all coagulated tissue leaving a raw surface except for the coagulation of individual arteries. Such a surface heals more rapidly than one that has been completely and repeatedly coagulated by a loop electrode and has less possibility of being the source of late

bleeding and of subsequent narrowing from late scar contraction (Fig 482).

It is preferable when the operation is completed that the irrigating fluid be highly colored for if all oozing is completely controlled and the wash water clear coagulation has been too thorough. When all individual spouting vessels are cared for one need not worry about general oozing. This will clear with the patient's return to bed with an indwelling catheter.

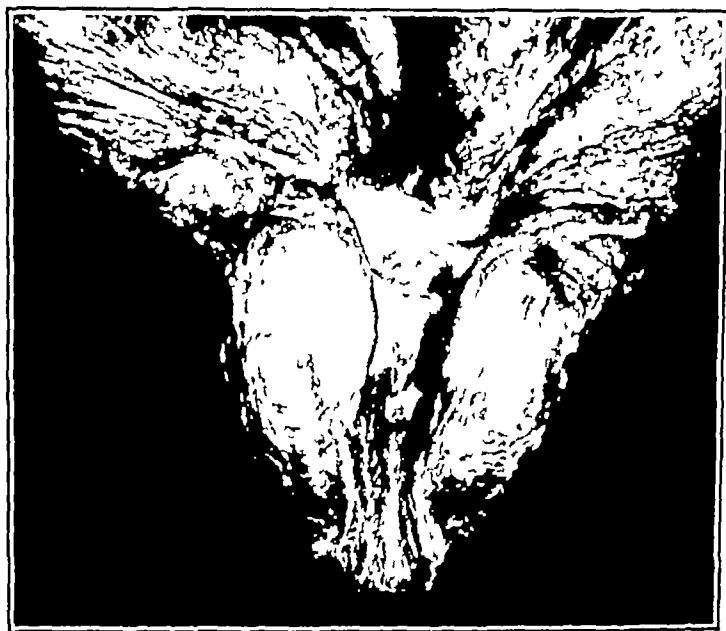


FIG. 482.—Prostatic urethra seven years after the removal of obstruction due to adenofibromatous hyperplasia. Patient had no recurrence of urinary symptoms and died of cancer of the larynx.

Kenneth M. Walker's Diathermy Punch—Walker of London after trying Caulk's punch and meeting with difficulties, chiefly electrical in nature, hit upon the idea of coagulating the tissue to be excised before excision and hence doing away with bleeding instead of coagulating it as Caulk did during excision. He had Schranz construct duplicate of the Caulk punch except that the entire instrument was covered with bakelite except for a small fringe of metal about the fenestrum (Fig 483). By running a diathermy current through this thin fringe of metal once the instrument had engaged the obstructing portion of the tissue projecting into the fenestrum it was rapidly coagulated, after which it was excised with a tubular knife. Walker's instrument was equipped with an observation lens system, light carrier and irrigating tubes, all similar in construction to those later added by Caulk to his instrument.

Diathermy as a means of hemostasis was also tried by Tolson, who instead of coagulating the tissue before excision constructed an instrument for coagulating the incised area after excision. He had con-

structed a shaft of bakelite which just fitted in the Young sheath and carried a metal plate the exact size of the fenestrum. When the tubular knife was withdrawn the bakelite shaft was thrust into the instrument and the plate placed in contact with the raw surface of the recently excised area and the current applied.

These two instruments represent the first employment of bakelite in the construction of urological instruments.

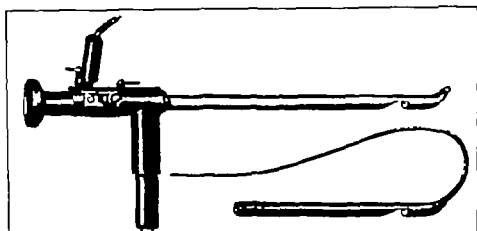


FIG. 483.—Kenneth Walker's diathermy punch

Day's Cysto-urethroscopic Punch.—Shortly after Young presented his punch instrument Day conceived the idea of controlling bleeding by thrusting into the tissue prior to excision a needle electrode. After the tissue was thoroughly coagulated he found it could be excised without bleeding. He reported 10 cases so treated in 1915 but due to the inadequacy of vision in the punch method as then used the method was abandoned. It was revived by him in 1930, when he devised a pistol grip instrument equipped with the McCarthy Foroblique lens system for vision in which a needle electrode first coagulates the tissue which is later cut away on the punch principle (Fig. 484). But with this difference, all previous punch instruments cut from the urethral side toward the bladder the Day instrument was so constructed as to cut from the bladder side toward the urethra which the author claims to be the more efficient method resulting in the obtaining of larger pieces of tissue with each bite.

The time saved with this instrument is also considerable he finds because the preliminary electrodesiccation obviates the necessity of high-frequency cauterization afterwards in the presence of active bleeding. Much emphasis is placed on the necessity of removing sufficient tissue so that the vesical orifice is not only free from obstructing tissue but also is everywhere even and rounded. Otherwise the sphincter cannot close perfectly because of these irregularities and asymmetry and hence a slight incontinence may result curable by removing the remaining obstruction under full vision. With the statement that the removal of one or two bites of tissue from the median lobe with

possibly an additional bite on each side is sufficient for most cases he heartily disagrees, stating "I have seen obstruction greater after three full-sized bites (persistently and unmistakably so) than it was before the punch operation was done"

Collings' Knife Electrode and Radiotherm —During the time Caulk was demonstrating the feasibility of removing obstructing prostatic tissue through an endoscope by cautery excision, rapid advances were taking place in the adaptability of electric currents to urological uses

Since Beer's demonstration in 1910 of the destructive action of high-frequency currents on tumors of the bladder little change had been made in the physical properties of these currents

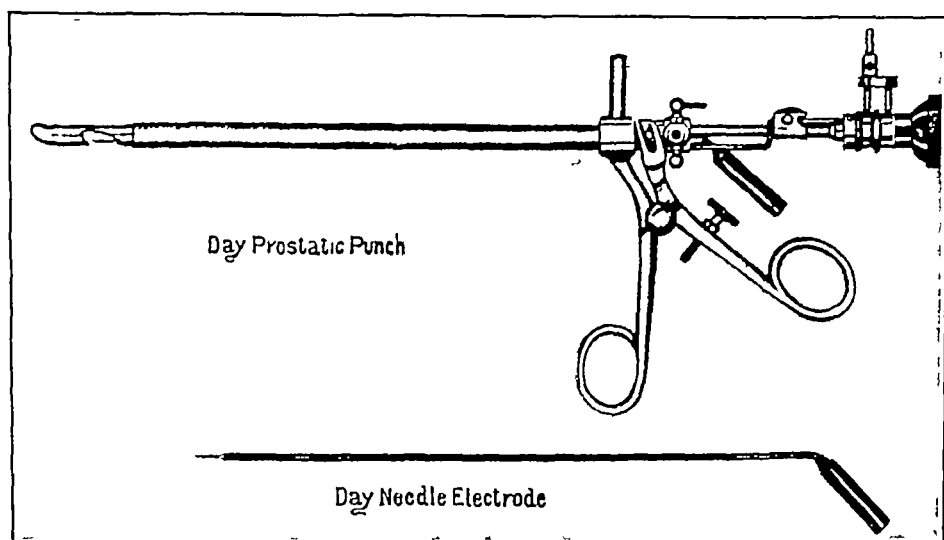


FIG 484 —Day's cystourethroscopic punch (Courtesy of the Jour Am Med Assn)

A R Stevens (and later Bugbee) had used the bipolar d'Arsonval current to desiccate sufficient of the posterior lip of the vesical orifice to form a shallow channel through it and suggested its use in the various types of contracture of the bladder outlet but the procedure was tedious and required several treatments for its completion, sometimes consuming months of time Collings believed this method had great possibilities if a current that would not only desiccate but actually cut could be developed

The late R Wappler obtained this for him by using a generator similar in principle to a radio receiving set which he called the radiotherm because of the tubes used in its construction By constructing a knife-like electrode for use through the McCarthy panendoscope Collings was able not alone to divide instantly any obstruction at the vesical neck but he could with the same instrument whittle away the tissue from each side of his median incision (Fig 485)

Also, he was able for the first time to excise as well as incise tissue under full vision by an electric current He was most conservative in his advice regarding its field of application, never advocating its adop-

tion in cases of adenofibromatous hypertrophy but holding it should be confined to contractures and cicatricial changes at the neck of the bladder

Not long after this work electrical engineers discovered that by appreciably stepping up the oscillations in the older spark gap diathermy machines their current could also be made to cut under water. The coagulating factor of this current seemed to be undiminished by this change. Collings found this damped current more efficient in his hands and later adopted it in preference to the radiotherm current.

Time and experience have since demonstrated the Collings knife electrode to have an ever widening field of usefulness for wherever intraurethral or intravesical incision are required it is applicable

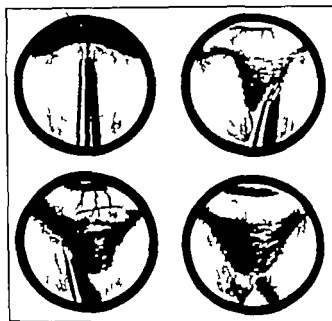


FIG. 485.—Collings knife electrode. *Jour. Urol.*, Vol. xxiv, No. 4, Oct. 1930, p. 437.

Acute prostatic abscesses may be incised and drained through the urethra under perfect vision. In patients with chronic prostatitis that repeatedly recurs Thompson and Clark have demonstrated that such recurrences were due to deep-seated chronic abscess pockets draining into the urethra through what appear as dilated prostatic ducts. The author had met with considerable success in the treatment of such cases by thrusting the Collings knife electrode deep into such pockets and then excising through the internal sphincter to the trigone. The procedure resembles the cutting of the rectal sphincter in cases of anal fistula. It permits the abscess to granulate in from the bottom and at each voiding the bladder urine washes it clear instead of remaining in it to stagnate. In some of the more extreme cases it is occasionally necessary to excise tissue with a punch or resectoscope from each side of the incision to insure a free and open passage from the bladder to the base of the chronic abscess pocket.

Stern's Resectoscope.—At the same time Collings was developing his instrument Maximilian Stern, also with the cooperation of Remhold Wappler, had devised an instrument called the resectoscope, the principle of which was destined in other hands to revolutionize the treatment of prostatic hypertrophy.

The instrument consisted of an outer straight sheath in which a fenestrum had been cut some 2 cm. in length. This differed from the fenestrum of the punch instruments in being of the same depth at both ends.

A tungsten wire loop of a diameter slightly less than that of the outer sheath was so arranged that it could be slid back and forth in the longitudinal axis of this fenestrum. By passing the new radio frequency current through this loop strips of tissue could be cut away in length equal approximately to the length of the fenestrum and in width the equivalent of the diameter of the loop. By including in the instrument a direct lens system, light carrier and irrigating conduit the excisions were carried out under vision of the operator, provided bleeding so profuse as to cloud the field did not occur.

Stern believed that the undamped radio frequency current cut by the molecular destruction of the tissue cells in immediate contact with the loop due to its tremendous frequency. He therefore considered the tissue beyond the thin layer of coagulation produced by the loop to be unaffected. The loop being less than $\frac{1}{2}$ cm. in diameter the pieces of tissue excised were very diminutive in size and to remove any considerable amount of obstruction was a most tedious procedure. In other hands than Stern's considerable difficulty was experienced with bleeding, while the loops as originally constructed proved so fragile as to require constant replacement.

So annoying were these handicaps and so difficult of correction that the method was very slow to be adopted by others until T. M. Davis made certain structural alterations in the loops that not only increased their strength and so prevented the costly necessity of their frequent replacement but also enlarged their diameter so that larger portions of tissue could be excised. The bleeding complicating excision he overcame by arranging a double foot switch by which he could pass a coagulating damped current through the loop electrode if bleeding occurred after excision with the cutting current, and so by drawing the loop back and forth over the denuded surface could render it bloodless. The large series of cases with good functional results which he reported demonstrated the practicability of the method in experienced hands. To Davis, therefore, the credit has justly gone for the popularizing of this method of transurethral resection of the prostate.

Stern-McCarthy Resectoscope — Utilizing the principle of the reciprocating loop as introduced by Stern, McCarthy with the cooperation of Frederick Wappler adapted it to his panendoscope, the sheath of which was enlarged in caliber and constructed of bakelite in place of nickel (Fig 486). Instead of having the loop travel back and forth in the opening of a fenestrum McCarthy had it project beyond the distal

end of the instrument and cut as it was drawn toward the operator. The loop being much larger than in Stern's instrument the operation could be carried on more rapidly and since the vision afforded by the Foroblique lens system is unsurpassed the instrument rapidly became popular. For those preferring a lens system of vision and the loop principle of excision it has become the instrument of choice.

Technique of Operation—The operation is begun in the midline with the cutting loop fully extended and beyond the obstruction. With the instrument grasped firmly in the left hand the loop is brought in contact with the distal portion of the obstruction. This is often not within the visual field as it is figuratively speaking over the top of the mountain. Once contact with the tissue is made the loop is drawn toward the operator by manipulating the control arm on the right side of the instrument and applying the current at the same time through a foot switch. As soon as the loop is completely within the sheath the current is discontinued. If the irrigating fluid is also turned off at the same time the hydrostatic pressure within the bladder forces

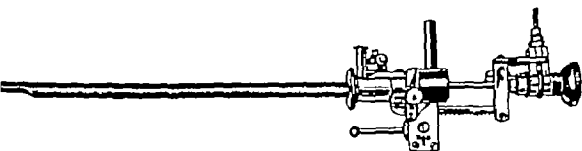


FIG 458—The Stern-McCarthy resectoscope. The most generally used instrument for resection of obstructive tissue at the bladder neck.

the tissue just excised into the sheath of the instrument and its prompt expulsion upon the removal of the operating mechanism from the sheath is assured.

Some operators prefer to excise several pieces of tissue before removing the operating mechanism, allowing them to accumulate in the bladder and washing them out at one time. In this event there is no necessity for regulation of the irrigating flow except to be sure the flow is not so rapid as to overdistend the bladder excessively.

There is some risk, however, to the frequent repetition of cuts emptying the bladder. The destruction of tissue incident to cutting is accompanied by the formation of gases. These accumulate in the dome of the bladder and have been known to form an explosive mixture and rupture it.

After a cut is made with the loop the surface is examined for bleeding points. It is essential that a rapid flow of irrigating fluid is constantly available for when excessive bleeding occurs the visual field may be quickly impaired and only by a copious and rapid flow of fluid is it

possible to locate the bleeding points, which are coagulated by passing the loop to and fro over them with a reduced amount of current flowing.

When all the obstruction of the floor of the sphincter has been removed by repeated cuts the lateral lobes are dealt with individually in a similar manner.

Foley's Endothermal Cystoscopic Excisor.—In principle as well as construction this instrument is a complete departure from all other types of resectoscopes. Instead of removing the obstruction in small pieces Foley's instrument excises the gland in its entirety, leaving it loose in the bladder.

This excision is accomplished by hinging the distal end of the instrument so that after entering the bladder its angulation may be increased. From the distal point a fine wire is pulled taut through an opening part way down the shaft. By running a high-frequency current through this wire and at the same time turning the instrument slowly a circular incision is made which embraces the entire obstruction. The excised mass now being free in the bladder, Foley uses a specially constructed forceps for tearing it into pieces sufficiently small to be removed through the urethra.

Kirwin's Rotary Resectroscope—This instrument, like Foley's, is constructed with the idea of excising tissue by the rotary motion of a wire through which a high-frequency current passes. Instead of being drawn taut and moving with the instrument the wire is in the form of a rotary loop which is manipulated by a lever and cuts and coagulates through a fenestrum in the side of the shaft. The instrument is a modification of an earlier model in which the incision was made with a circular knife after the tissue had been pinioned and coagulated by a needle electrode. Kirwin feels that cutting in direct contour of the vesical neck to be advantageous and that the lateral position of the wire enables the operator to obtain larger sections.

Cecil's Electrome—That certain cases of prostatic hypertrophy as well as contractures of the bladder neck and cancerous infiltration are benefited by simple incision of the vesical orifice there is no doubt for the history of transurethral work abounds in the reports of good functional results obtained by Guthrie, Mercier, Bottini, Geraghty, Collings and others by simple incision without the removal of any tissue. Geraghty and Boyd hold that the cutting of the internal sphincter with its resulting complete relaxation explains these good functional results and Geraghty called his instrument a sphincterotome.

While Cecil does not commit himself on this point, he is most emphatic in his belief that it is the depth of the cut and not its width that insures satisfactory results with this type of treatment. Believing that no fenestrated instrument can cut sufficiently deep he has designed a lens instrument that carries an electro cutting knife which can be projected to a depth that creates an enlargement of the urethra to a diameter of $2\frac{1}{2}$ cm.

Its applicability to any given case has to be determined by thorough urological examination but when so employed it has had a much wider field of application than Cecil anticipated.

TYPES OF ELECTRICAL CURRENT USED

For use with the Stern McCarthy instrument Frederick Wappler designed the McCarthy Complex Oscillator generator which delivers a radio frequency or undamped current unsurpassed in its cutting qualities and this generator is never overburdened due to its abundance of reserve power. It seems generally agreed, however, that the coagulating qualities of this type of current are inferior to those of the damped current obtained from the older diathermy plate machines. To overcome this defect and produce the maximum of coagulation obtainable it was necessary to increase the surface area of the cutting loop. Having so great a reserve of cutting power this was easily done by making the diameter of the wire used in the loops greater, a factor which also made them stronger. McCarthy carried this principle still further by designing special loops for coagulation only in which the surface area was still further increased by attaching to the loop a shot like roller. He states that "It is the invariable rule of the author to employ two telescopic attachments ready for immediate use, one for the electro-tome and the other with coagulating equipment."

Rival manufacturers were not slow in appreciating this weakness in the radio frequency current and soon discovered that by sufficiently stepping up the oscillations of the damped current from plate machine this type of current could also be made to cut under water as well as merely desiccate tissue. To accomplish this the wire in the loops had to be very fine for the cutting ability is in inverse ratio to the diameter of the wire used. The coagulating qualities of the damped current being in no way lost by this change the control of bleeding was much easier, not alone because the same loop could be used for both cutting and coagulating but because with this current less bleeding occurred at the time of excision.

As a result there appeared on the market wire-loop electrodes, the diameter of the wire in which was much reduced for use in the Stern McCarthy resectoscopes when the operator preferred to employ a damped current because of its superior coagulating qualities. Some urologists solved the problem as Davis had in his pioneer work by employing a double foot switch, cutting with the undamped current and coagulating with that from a plate machine. This however requires the use of separate generators which adds to the expense. It is probable that a combined machine will ultimately solve the difficulty although the cutting qualities of the damped currents as delivered by modern generators leave little to be desired and the coagulation obtained with the modified loops of McCarthy using an undamped current is found sufficient by many operators.

EDITOR'S NOTE.

[In the present state of opinion in regard to the choice of methods of prostatectomy it seemed quite clear that it would be difficult to get any thoroughly competent expert to deal with the various methods

impartially Doctor Young was therefore asked to assume a large share in the chapter, including the technical questions involved in perineal prostatectomy. This operation is largely his own child, although he of course based it upon the work of his predecessors. By no one in the world has it been developed so far, and by no one has it been taught to so many pupils. Doctor Squier has for years been one of the outstanding experts in this country in suprapubic prostatectomy. His experience and skill entitle him to express authoritative opinions. The operation of transurethral resection in this country belongs largely to the younger generation, although it of course has its roots in the past. Of this group Doctor Bumpus is an outstanding example, and his experience in the operation is probably as great as any of its exponents.

Having obtained these expert opinions there is of course just a chance that they will have a certain *ex parte* flavor which may leave the innocent bystander in some confusion. An attempt will therefore be made to survey the situation from what it is hoped will be a neutral position.

Of course the fact of the matter is that they are all right. Doctor Young is entirely correct in his view that in his hands and in the hands of some of his pupils, perineal prostatectomy has a very enviable record. Doctor Squier is entirely correct in his view that for the surgeon not very expert in major urological surgery, suprapubic prostatectomy has been the method of election. Finally, Doctor Bumpus is entirely correct in his view that an operation, which, in the hands of experts, shows such a low mortality, such a short confinement to hospital, and such apparently satisfactory results, is entitled to its day in court.

The real nub of the question turns upon the decision as to who is to treat by operation these people with obstructing prostates. If they are to be treated in the future as in the past largely by the general and perhaps occasional surgeon, then the indication is for an operative method as nearly fool proof as may be. But this does not seem a very high ideal for surgical practice. If this is the standard which we are to accept, then we must take with it a mortality, which, in this country at least, has rarely been below 15 or even 20 per cent. That any elderly man is likely shy at such a risk will be evident. If we are to take the view that the low mortality can be obtained only in the hands of experts, and that as time goes on each nation must be prepared to provide such experts for the care of its people, then we may easily come to a very different conclusion.

Assuming for the moment that these operations are to be done by experts, we shall then have difficulty in avoiding the conclusion that the suprapubic approach, even in the best hands, has rarely shown a mortality below 6 per cent, that it requires confinement to bed on the average for four or five weeks, and is a considerable strain not only on the patient, but on his pocketbook.

On the same premise we shall have to agree with Doctor Young that in expert hands the perineal operation has a lower mortality than the

suprapubic and gives excellent results. The hospital confinement, although considerable, is perhaps somewhat less than that of the suprapubic method, but it still involves a risk and an amount of confinement which is noteworthy as compared with the promise of transurethral resection.

Again assuming that only experts will do the work, transurethral resection, whether by the electrocoagulation method of Stern, Davis and McCarthy, or the so-called punch type of operation of Caulk, Bumpus and Thompson, has made such an extraordinary showing as to deserve very serious consideration. There are now careful observations of not less than 4000 or 5000 cases, showing a mortality less than 2 per cent, a hospital confinement averaging less than seven days, and functional results quite the equal of either of the other operations over the period during which observation has been possible. This showing cannot be laughed off, but must be squarely faced. The objections raised to the operation are hemorrhage and infection, which are in fact our two old friends with which the operations of suprapubic and perineal prostatectomy have been struggling for two generations. It seems to me quite clear that considering the relative youth of this last candidate for approval, he is making relatively good weather of it as compared with his older brothers who at his age were shockingly lethal for these same two reasons.

The further objection is raised that the functional results, although temporarily good, will not be permanent. This question cannot be definitely answered yet, and may perhaps be valid. On the other hand, we shall do well to remember that neither the suprapubic nor the perineal operation have an entirely clear record as to long time functional results. Years ago, having in mind the very poor functional results of earlier operations, we were inclined to be pretty well satisfied when after prostatectomy, by either method, the patient could substantially empty his bladder and had no serious frequency of urination. But as time has gone on, all of us who have been intimately associated with such surgery have seen many cases in which, as the years have rolled by, the patients have returned with recurrent obstruction, badly infected bladders, and pretty shaky kidneys. For them we had nothing to offer but another prostatectomy, and many of them, if they could carry on, were inclined to take their chances with out it. If the late functional results of transurethral resection should lack something of the permanency of the more complete operations, it cannot be doubted that the patient will face a second operation with much less hesitation than in the past—and he will be right about it.

It is perhaps safe to guess that suprapubic prostatectomy will long hold a place where expert urologists are not available. Perineal prostatectomy will have to fight it out with the transurethral resectionists. Both of the operations require prolonged training, great skill and dexterity, and large experience. Given these in equal measure, I suspect that the younger generation, armed with better equipment, will win the day for transurethral operations.

CHAPTER XIX

CANCER OF THE PROSTATE

By HUGH HAMPTON YOUNG, M D , F A C S , Hon F R C S I

CANCER of the prostate has until recent years been considered an infrequent disease. The first statistics as to the frequency was apparently an article by Tanchou, who analyzed 8289 cases of cancer in Paris between the years 1830 and 1840 and found only 5 cases diagnosed cancer of the prostate.

Gross, in Philadelphia, was one of the first to furnish definite data in regard to cancer of the prostate about 1850, but it was not until Sir Henry Thompson, in 1861, in his monumental work on the *Diseases of the Prostate*, recognized the importance and predicted the future frequency of the disease.

Thompson published 12 cases, and remarked that cancer of the prostate was probably overlooked frequency, especially in the more chronic forms or indeed where it developed in an already hypertrophied prostate.

Von Recklinghausen contributed greatly to the subject by demonstrating that osseous metastases not infrequently came from cancer of the prostate which was often unrecognized.

The disease was nevertheless considered rare. Socin and Burckhardt, in their splendid book *Krankheiten der Prostata*, in 1902, even held it was seldom met with, until Albarran and Hallé published their "discovery" of 14 cases of carcinoma in 100 supposedly benign prostates and brought to the attention of the surgical world the considerable frequency of cancer of the prostate. This was followed by papers by Motz, Kautmann, Hawley, Young, Pousson, Montfort, Hallopeau, Kummell, Freyer, McGrath, Wildbolz, Verhoogen, Schapiro, and Willms, thus leading to a much greater concentration of interest in and wider diffusion of knowledge of cancer of the prostate.

Frequency—Statistics vary as to the general frequency of cancer of the prostate. In the studies from the records of the Institute of Anatomy in Munich there were 29 cases of cancer of the prostate in 5777 autopsies, or 2 per cent, whereas in Brussels there were only 0.7 per cent among all, or 1.8 per cent among males. In the last fifteen years cancer of the prostate has been accorded an increasingly important role and frequency as compared with hypertrophy of the prostate.

As remarked above, in 1900, Albarran, in a study of 100 specimens of prostatic hypertrophy in the Musée Guyon, discovered malignant changes—"epithelioma adenoïde"—in 14 cases. This caused Geraghty and myself to study our clinical and pathological material

thoroughly and whereas we were unable to confirm Albarran's findings we were able to show a far greater clinical frequency for carcinoma of the prostate than had been recognized previously (21 per cent).

I made the statement ¹² In the five years between 1902 and 1907 I have seen 200 cases of benign hypertrophy and 68 cases of carcinoma of the prostate (21 per cent). I am aware that my figures attribute to cancer a more frequent occurrence than any other in the literature but I believe they represent the true condition.

Since then there have been numerous confirmatory publications. Oliver Smith's statistics gave a proportion of 16 per cent. Davis 20 per cent. Moullin 20 per cent. Kimmell 20 per cent. Pauchet 20 per cent. At the Institute of Pathology in Munich among 103 deaths from "prostatic accidents" there were found 27 cancers. Wilson and McGrath studying 468 prostatectomy specimens removed at the Mayo Clinic found that 73 were cancer or 15.6 per cent. Freyer has recorded clinical diagnoses of cancer in 171 cases among 1276 cases of prostatic enlargement or 13.4 per cent. Microscopic examination of his operative specimens has not been carried out in all cases so the percentage may be higher.

These statistics are sufficient to show that cancer of the prostate is a fairly common disease and a very important problem in the surgery of the prostate, especially as the importance of early diagnosis and radical excision has been so conclusively demonstrated.

Two startling articles concerning the frequency of cancer of the prostate have appeared recently. Rich¹³ reports that in 292 consecutive autopsies on males fifty years or more of age dying from a wide variety of causes on the medical surgical and urological services of the Johns Hopkins Hospital during the past three years frank carcinoma of the prostate was found in the routine microscopic section taken at autopsy in 41 cases or 14 per cent. There is little doubt that a thorough search throughout each gland would have brought to light an even greater number of these tumors many of which were so small that they were not seen macroscopically at the time of autopsy. The number discovered however indicates plainly enough that cancer of the prostate is considerably more frequent than is ordinarily supposed. In 65.8 per cent of these 41 cases the tumor was not recognized clinically having been in most cases of a size too small to have produced symptoms, or to have attracted attention on physical examination. Of the 292 cases 83 were from the Urological Service and among these 17 cases of cancer of the prostate were discovered (21 per cent). Twelve of these cases were diagnosed clinically, 5 not diagnosed. Of the cases between fifty-five and sixty years 11 per cent showed cancer between sixty-six and seventy years 21 per cent between seventy-one and seventy-five years 28 per cent between seventy-six and eighty years, 37 per cent, and between eighty-one and ninety years 20 per cent. Rich proved conclusively that there was no doubt that in each case he was dealing with a definite invasive carcinoma.

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autonomous proliferation of epithelium which has already undergone atrophy.

A study of the cases of carcinoma which arose in a gland also the seat of benign enlargement shows that the two disease processes are not related. In my first table the percentage of carcinomas in such glands is approximately the same as the occurrence of benign enlargement in the entire series.

It is evident therefore that Moore has come to the same conclusion we did in 1906 ¹⁴: carcinoma in the large majority of cases begins in the posterior subcapsular portion—posterior lobe—of the prostate and is quite independent for a long time of hyperplasia of the lateral and median lobes, which either may precede or both may develop concurrently.

Moore stated: In these 52 cases just detailed there is no clinical or gross pathological evidence of extraprostatic metastases. In 4 there is microscopic invasion of the seminal vesicle in 3 by an apparent direct continuity of malignant disease and in 1 with an area between the primary focus and the vesicles free of tumor. These 4 are the largest tumors of the 52. Observed from the viewpoint of the general problem of invasion and metastases, carcinoma of the prostate exhibits early invasion of the perineural lymphatics within the organ but metastases and invasion outside the organ is a late manifestation of the disease.

In Moore's 52 cases of occult carcinoma the gross diagnosis was made in only 10. We believe that with another similar series of cases a better percentage would be obtained. The lesion is a firm white or whitish yellow irregular mass not sharply delimited from the surrounding tissue. Dependent upon the acinar differentiation and amount of desmoplasia it may be granular or fibrillar. In our experience there are only two confusing lesions: focal atrophy and hyperplastic tuberculosis. In the former the focal area is also irregular not sharply delimited and firm but it has a bluish white translucent appearance. The latter is yellowish white and usually has a moderately sharp scalloped border.

Moore concludes that carcinoma of the prostate occurs with increasing frequency until the ninth decade when it reaches 20 per cent that carcinoma is intimately associated with senile atrophy and is predominantly a lesion of the posterior lobe that carcinoma and benign enlargement of the prostate are two distinct diseases which occur independently that it rarely occurs in acini already hyperplastic, and already involved in benign enlargement.

The splendid pathological studies of Rich and of Moore which have been described above in detail contain clinching evidence of the great frequency of carcinoma of the prostate which in 1906 we stated to be in 21 per cent of the patients presenting themselves on account of prostatic obstruction. Their statistics indeed show it is far more prevalent than suggested by us and furnish a powerful argument as to the importance of early and frequent rectal examinations to detect

Moore¹³ states that he found cancer in the prostate at autopsy in 21 per cent of patients over forty-one years of age. His material was obtained from autopsies at the two hospitals in Vienna during 1931 and 1932, 675 cases in all. "The gland was dissected free from the surrounding tissues, and fixed uncut in 10 per cent formalin for ten days or longer. After fixation blocks not over 4 mm in thickness were cut and paraffin sections, stained with hematoxylin and eosin, prepared. The blocks were routinely coronal sections, but horizontal and sagittal sections were cut in some cases. In all 675 prostates, the entire prostate was cut into blocks and one microscopic section prepared from each block. The blocks were not subdivided unless they were larger than 5 by 3 cm. By this step section method (not serial section) all lesions larger than 4 mm in diameter could be studied microscopically." In 52 patients under forty-one years of age no carcinoma was found. In 242 patients over forty-one years of age the youngest patient in which carcinoma was found was forty-four years of age. These 242 patients were between forty-one and ninety years of age, and among them 51 cases of carcinoma were discovered, or 21 per cent. The details are given in the table below. In 52 cases the lesions were small, and an accurate determination of the point of

OCCURRENCE OF CARCINOMA AND BENIGN ENLARGEMENT

Age group	Prostates examined	Per cent which show carcinoma	Per cent which show benign enlargement	Per cent of carcinomas which arose in a prostate with benign enlargement	Per cent of benign enlargement which also show carcinoma
21-30	24	0	0	0	0
31-40	28	0	4 (1)	0	0
41-50	23	17 (4)	30 (7)	25	14
51-60	65	14 (9)	37 (24)	50	21
61-70	77	23 (18)	67 (52)	66	23
71-80	63	21 (13)	68 (43)	46	14
81-90	24	29 (7)	75 (18)	71	27

origin could be determined. Fifty, or 73.7 per cent, arose in the posterior lobe, that portion of the gland posterior and postero-lateral to the fan-shaped ducts which enter the sides of the urethra. Six, or 8.8 per cent, arose in the lateral lobes, that portion medial and anterior to these same ducts. Ten, or 14.8 per cent, arose in the anterior lobe, that portion which drains into the anterior furrow of the urethra. None has been observed in the middle lobe, that portion between the urethra and deferential canals and cephalad to the colliculus seminalis. In 1 case there was complete carcinomatous infiltration of the middle lobe, but the posterior lobe was also involved, and the focus of origin could not be determined. In all cases except the two which arose in area of benign enlargement, the area of carcinoma is surrounded and infiltrated by glands typical of senile atrophy. The occurrence of this atrophy in non-carcinomatous cases follows closely the anatomical distribution of carcinoma, and we believe that carcinoma of the prostate in the vast majority of cases results from stimulation and

these may extend upward for a long distance the outer walls of the vas remaining apparently intact that the muscle of the trigone and bladder and also the peritoneum may be invaded from this subtrigonal involvement and finally that the fascia of Denonvillier which gives the prostate its most dense capsule posteriorly is a most effective agent in preventing involvement of the rectum and periprostatic structures.



FIG. 187 — Showing the capsule surrounding adenomatous hypertrophy (above) which has resisted extensive adenocarcinoma (below)

Histology — Perhaps we can make our description of cancer clearer if we first give our impression of the appearance of the normal prostate and in benign hypertrophy.

The tissue of the normal prostate is rather grayish in color and somewhat moist. It is soft in consistency but tough. On pressure a small amount of prostatic secretion can frequently be squeezed out. The cut surface is apparently smooth and homogeneous but on close inspection the tiny glandular orifices can be discovered. Sometimes the orifices of dilated acini are very evident.

The tissue of benign prostatic adenoma is usually quite characteristic. It has a lobular appearance due to the formation of varying sized spheroidal tumors often definitely encapsulated the lobular mass as a whole being compressed by a more or less well-developed capsule formed from the condensed peripheral prostatic tissue. The tissue is usually elastic or soft in consistence and on section is moist. Frequently large quantities of a milky fluid ooze from the prostatic acini. Many of the lobules have a moth-eaten appearance due to the presence of dilated acini. In other lobules where the glandular elements are

indurated areas in the prostate, and perineal exposure of the prostate when a negative diagnosis cannot be made by rectal examination

Etiology.—The etiology of cancer of the prostate is as obscure as that of cancer in general. It appears at about the same period of life as hyperplasia—after forty years—and most frequently between sixty and seventy years of age.

There is nothing to show that a preceding prostatitis or hypertrophy of the prostate has any causative relation, although both frequently occur with cancer of the prostate. Our studies seem to show conclusively that "malignant degeneration" of hypertrophied lobes does not occur frequently, if at all, and the lesions which Albarran and Hallé described as malignant changes, "epithelioma adenoide," in otherwise benign prostatic enlargements have been seen so often in other conditions—manifestly not malignant—that we cannot consider them to be even forerunners of cancer of the prostate. "Our view has since been confirmed by Tietze, who has met with analogous cellular masses in young prostates, and attributes to them an important role in the development of the gland. Casper, Renge and others have described them in hypertrophy of the prostate. Finally, Brault, Menetrier, and Darier, who have studied them in a case of Pasteau, do not consider them as epitheliomatous but as tangential cuts of normal glandular masses" (Verhoogen). Our pathological studies (1915) show hypertrophy present with cancer in 61 per cent of the cases of cancer of the prostate.

Studies made in 1906¹⁴ seemed to show that prostatic hypertrophy was largely a disease of married men. At that time I remarked that in corroboration of this I had never seen a case of enlarged prostate in a Catholic priest, although there had been many cases among married Protestant ministers. Since then two priests with enlarged prostate have been encountered, one a very large benign adenoma, the other cancer.

Pathology —As remarked above, we feel convinced that carcinoma of the prostate does not result as a degeneration of the previously benign adenomatous process, that in about half of the cases it develops where no hypertrophy is present, that in such cases the prostate is often little if at all enlarged, that the carcinomatous growth follows planes of least resistance, that it is very slow in invading fibrous capsules (Fig. 487), both of the prostate itself and also of hypertrophied spheroids, lobules or lobes, that the mucosa and submucosa of both urethra and bladder are also very resistant to it, that the most common site for the beginning of cancer is in the posterior subcapsular stratum of lobe, and that from there it may invade the rest of the prostatic glandular tissue or it may travel upward, escaping from the upper end of the prostate in the region about the ejaculatory ducts, and between the fascia of Denonvillier posteriorly, and the trigone anteriorly, that in its further growth the seminal vesicles and vasa deferentia may not become infiltrated, but in some cases their lumina may become filled with cancer cells and, in the case of the vasa deferentia,

may be almost wanting or the fibrous stroma is so dense that the cancer cells are often not recognizable, small nuclear specks being alone visible. This may lead to error of diagnosis if only a small section is examined. At other times definite masses or infiltrating lines of irregular-shaped cancer cells are seen the size and shape seeming to depend largely upon the compressing force of the fibrous stroma.

Those of the adenocarcinomatous type present most varying pictures. At times acini formed of irregular cells, often with big deep-staining nuclei are scattered at wide intervals the intervening tissue being more or less densely infiltrated with cancer cells. At other times the cancer acini are so numerous and close together that the fibrous stroma may be difficult to see. The acini in these areas are usually very small and lined by small cylindrical cells often quite irregular in shape and with small rounded nuclei. Often over large areas no attempt at a glandular reproduction occurs cancer cells simply growing aimlessly through a fibrous stroma. Occasionally normal acini are found persisting in large areas of cancer.

Cancer of the prostate spreads in two ways by direct extension through the stroma and by extension along the ducts. As a result of this duct extension one sometimes sees masses of cancer cells filling the acini the intervening tissue being entirely normal.

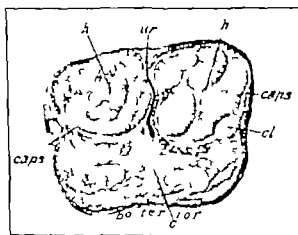


FIG. 488.—Transverse section in front of verumontanum, showing two large hypertrophied lobes on each side of the urethra and thick posterior subcapsular area of carcinoma. Capsule of right lateral lobe invaded in one place (cl).

Cancer Associated with Hypertrophy—In our first cases in which cancer and hypertrophy were present together (48 in 71 cancer cases or 61 per cent) the cancer as remarked before generally formed a layer beneath the posterior capsule and the hypertrophied lateral lobes lay in front of and distinctly separated from cancer by their own capsules which are generally intact (Fig. 488). In our series of radical operations for cancer of the prostate, pathological studies now show adenomatous hypertrophy present in 57 per cent. When the cancer breaks into a hypertrophied adenomatous lobule it spreads rapidly

not so numerous, and the stroma predominates, the surface is rather smooth and slimy

Practically no difficulty is encountered in differentiating carcinomatous prostatic tissue from the tissue of hypertrophy or of the normal prostate, presupposing, of course, that the carcinomatous area is of sufficient size to be discernible. The greatest difficulty arises from the tissue of a long-standing fibroid prostatitis. Carcinoma is usually quite characteristic. It is hard, dense, and on pressure gives very little sense of elasticity (which is generally still present even in well-advanced fibroid prostatitis). On cutting into the carcinoma it imparts a gritty sensation to the knife blade. No secretion oozes from the cut surface, which is rather homogeneous, lacking the lobulation so characteristic of hypertrophy. Occasionally where the cancer has invaded a previously benign adenoma an indefinite lobulation may persist in this tissue, but it is seldom confusing.

The finer details of the cut surface vary. Sometimes irregularly interlacing translucent bands of varying size are seen with small grayish-yellow islands scattered here and there, the translucent bands being fibrous in character, and the yellowish areas accumulations of cancer cells. This appearance is not present in fibroid prostatitis, in which the epithelial elements practically disappear, and the surface is much more smooth and homogeneous than in cancer. Where the cancer is infiltrating in character, fine alternating translucent and yellowish lines can frequently be seen by the aid of a small magnifying lens. Usually one can be moderately certain of the cancerous nature of the tissue from gross inspection alone. When the operator's knife, in making the capsular incisions, cuts through dense tissue which does not bulge, the edges of which are firm and rigid, suspicion should be at once aroused.

If after passing through such a layer of hard tissue a bulging hypertrophied lobe is encountered, the diagnosis of coexistent cancer and hypertrophy is generally justified. The capsule of the average hypertrophy is rarely thick, nor is it so dense and gritty as that of cancer.

Microscopic —The histological character of cancer of the prostate is very variable, being greatly modified by the character of tissue invaded and age of cancer and the method of extension.

A classification according to type of cell is, as a rule, impossible, as no one type is preserved throughout, the same section often showing great varieties of shapes and sizes. In our 2 cases in which cancer areas a few millimeters in diameter were discovered in the specimens removed at operation the microscope showed a definite adenocarcinoma, but in one of these, even at this early stage, marked infiltration into the stroma had begun.

In 10 apparently primary cases the cancer more often tended toward the scirrhus type, 7 being of this type. In 3 cases no glandular formation was present, in the other 4 cases occasional small groups of atypical acini were seen, but the great bulk of the tissue was scirrhus. At times the fibrous overgrowth is so marked that epithelial elements

entails any difficulty except in the scirrhous, where occasionally over small areas, the fibrous overgrowth may be so intense that no definite epithelial elements are recognizable, small scattered nuclear specks alone being visible. However this fibrous density is of itself suspicious and a section from a different area will usually at once settle this doubt.

Symptoms.—From a surgical standpoint the early symptoms in carcinoma of the prostate are the important ones, and unfortunately a survey of the literature is of little help in this respect. At the onset it is necessary to distinguish between early and late cases.

In a study of 12 early cases¹² I found it necessary to make three subdivisions:

- 1 Those in which the only pathological process present is cancer 6 cases.
- 2 Those in which cancer is associated with hypertrophy 5 cases.
- 3 A case of chronic prostatitis with a small area of cancer in it.

Class 1 furnishes the most satisfactory group for study and we find the following:

	Cases
Age between 60 and 64 years	3
" " 65 and 69 "	2
" " 70 and 74 "	1
" " 75 and 79 "	1

Duration of symptoms before admission

	Cases
6 months	1
1 year	3
2 years	1
3 years	2

The initial symptoms were as follows:

Frequency of urination	1 case duration 2 years
Difficulty of urination	1 " " 1 year
Urgency of urination	1 " " 1 "
Pain in penis during urination	1 " " 1 "
Frequency and difficulty of urination	2 cases, " each 3 years

Subsequent symptoms were present as follows. Pain in the penis and perineum came on two years later in 1 case. None of the other 5 patients suffered at all from pain. Hematuria was never present in any of the 6 cases.

In 1 case the catheter life was begun eighteen months after the initial difficulty of urination and was followed for eighteen months before admission. The other 5 patients had never used the catheter.

There were apparently no other symptoms present in these 6 cases and a consideration of those present shows there was nothing diagnostic or even suggestive of cancer present. The surprising thing is that in 4 of the 6 cases symptoms had been present for periods of two years or more. The fact that careful pathological examinations of the lateral and median portions of these prostates failed to reveal any benign adenomatous hypertrophy seems to point to carcinoma as being the sole cause of the obstructive symptoms in these cases.

along the ducts, thus giving an extremely puzzling picture of glandular acini lined or filled with cells different in type from the cells of the ducts or acini of an adenomatous hypertrophy, but with a basement membrane often intact and a normal intervening stroma. Frequently a single layer of cells will reline a duct or acinus so that except for the character of the cell the acinus looks entirely benign. However, we have never seen these broad cylindrical cells with clear, pale-staining protoplasm and nuclei centrally placed either in the normal or the hypertrophied prostate. In other acini the cells are heaped up at different points along the gland wall, and grow across the lumina sometimes in solid masses, but more frequently as interlacing strands. Sometimes the cancer cells arrange themselves circularly, leaving a central lumen as if in an attempt to reproduce a gland structure. When the lumen is completely filled the cells crowd each other into most odd and peculiar shapes.

These areas of duct carcinoma are not apt to be mistaken for benign tissue if the character of the cells is noted. Particularly characteristic is the tendency of cancer cells to grow in strands across the lumen of the acinus without any supporting connective-tissue framework. This does not occur in hypertrophy. In the latter when an epithelial budding from the wall of the acinus occurs, it is quickly followed by a supporting stem of connective tissue. It has been said that the acini of the normal or hypertrophied prostate when filled with desquamated epithelial cells may be difficult to differentiate from cancer of the duct type. With exercise of ordinary care no confusion from this source should occur. Later, with the advance of the main growth through the stroma or the breaking through from the acini, the picture is changed. The tubules of cancer cells with a more or less densely infiltrated stroma are seen, sometimes the intervening tissue is scirrhous, sometimes of an adenomatous type, and sometimes the cancer cells are so closely packed that a fibrous stroma seems almost entirely absent and a medullary form of cancer is produced. Sometimes portions of the cancer seem more or less definitely alveolar. When the cancer invades hypertrophied lobes of the adenocystic type, in which the interacinar stroma is frequently small in amount, the picture presented is that of cancer cells packed in the dilated spaces, resulting in an alveolar form of carcinoma medullary in character. In none of our specimens, either primary or those associated with hypertrophy, was a pure adenocarcinomatous type preserved throughout. Areas of adenocarcinoma were present, however, in great or less degree, in practically every case except in the three cases of pure scirrhous previously mentioned, in which the cancer occurred in a prostate not previously hypertrophied.

Very rarely have we found evidence of gross or microscopic necrosis, no matter how extensive the disease. The extensions of the disease to the seminal vesicles and bladder are usually infiltrating in character, although frequently the adenomatous form is here and there discovered. For one familiar with the histological character of the normal and hypertrophied prostate, the microscopic diagnosis of cancer seldom

abruptly forming a straight edge well elevated above the normal left half of the prostate. The lower portion of the right seminal vesicle was involved as was the posterior part of the membranous urethra. The contrast between the two halves of the prostate here was most sharply defined. In 1 case there was a hard nodule in each lobe, which was otherwise soft on each side. Two years later the whole prostate was rough irregular, very hard and greatly enlarged. In the other 4 cases although in 2 symptoms had been present only one year, the prostate was completely invaded by cancer on both sides although the vesicles were mostly free.

In a recent case not tabulated above the first examination three years ago showed a nodule 1 cm. in diameter in the left lobe. At the next examination two years later it was 2 cm. in diameter and one year later all of the left lobe was involved but it was still within the prostatic capsule. This case shows the remarkably slow growth in some cases.

The 3 cases associated with hypertrophy are interesting. In Case I (J. T. Y. No. 463) the prostate was considerably enlarged smooth rather hard in consistence. Microscopic study showed benign hypertrophy associated with prostatitis on both sides with only one small area of cancer in prostatic tissue which was the seat of prostatitis.

In Case II (T. C. S. No. 2750) in which symptoms had been present only six months the left lobe was only slightly enlarged smooth and elastic. On the surface of the right lobe there was a prominent lobe 1 cm. in size which was quite hard but seemed elastic on pressure. (This proved however to be entirely cancerous.) The right lobe was otherwise very little enlarged and the seminal vesicles were not indurated but nevertheless cancer was present in the lower portion of the left seminal vesicle. The left lobe when removed was found to be a benign hypertrophy the right being cancerous.

In Case III (W. J. R. No. 1779) the prostate was moderately enlarged and generally indurated (but not stony) with three very hard nodules present, one in the median line near the apex one at the upper end of the left lateral lobe and one near the apex of the right lateral lobe. Seminal vesicles negative. At operation a layer of cancer beneath the posterior capsule was found on the left side beneath which was a benign hypertrophied lobe on the right side and also in the median portion benign hypertrophied lobes were removed.

In Case IV (J. R. admitted June 26 1905) the prostate was moderately enlarged smooth the right lobe was elastic and only slightly indurated. Operation showed a posterior layer of cancer with a hypertrophied lobe beneath. The left lobe was smaller and softer, and proved to be benign hypertrophy.

In Case V (F. G. W. No. 206) the prostate was considerably enlarged smooth but very hard. Examination showed a posterior subcapsular layer of cancer with benign hypertrophy in front of it on both sides.

A review of these 5 cases shows that the presence of hypertrophy of

The complete absence of hematuria at any time shows, as I have pointed out before, the error of expecting this as an early symptom. It is distinctly more common in benign hypertrophies (except possibly late in the disease).

Subsequent experience confirms the statements made above in the second edition.

Class 2 The 5 cases in which cancer and benign hypertrophy existed together in the same prostate were as follows

Case	I	Aged 60 years, beginning with frequency three years before.
"	II	" 69 " " " frequency six months before
"	III	" 75 " " " sudden complete retention ten months before
"	IV	" 78 " " " frequency four years before
"	V	" 67 " " " frequency and difficulty two and a half years before

In Case 1 there was pain in the end of the penis before and during urination and in Case V a sciatica. In none of the others was there ever any pain present. Hematuria did not appear in any case.

Regular catheterization was necessary in Case V for one year, in Case II for ten months, and in Case IV for four months. In Case I suprapubic drainage became necessary three years after onset.

Class 3 The case in which chronic prostatitis was present along with a nodule of cancer was a man, aged sixty-one years, who for fifteen years had had symptoms of irritation in the deep urethra and attacks of frequency of urination. Catheterization was never necessary and hematuria and pain were never present.

In conclusion it seems from a study of the above early cases (and other later cases) that the symptomatology of cancer of the prostate in the early stages is almost identical with that of benign hypertrophy, so that we must look entirely to a careful physical examination to furnish suspicion of cancer.

The Examination — There was nothing in the appearance of any of these 12 patients to suggest malignant disease, they were not emaciated nor were they suffering pain, with the exception of 4 cases, and in these it was not severe. The urine was free from blood in all cases.

In the 6 cases not associated with hypertrophy the size of the prostate was described as considerably enlarged in 3 cases, moderately enlarged in 2 cases, and slightly enlarged in 1 case. The surface was smooth in 2 cases, rough in 3 cases, nodular in 3 cases. Here we have in 6 cases conditions which should always make one suspicious of cancer, for the benign adenomatous prostates, unless associated with considerable inflammation or with calculi of the prostate, are nearly always smooth, though they may be lobulated. The consistence was described as very hard in all of the 6 cases not associated with hypertrophy, and in some was said to be "stony hard." In 5 cases both lobes were involved, but in 1 case the left half of the prostate was normal. In this interesting case (in which an urgency of urination had been present one year) the right lobe was enlarged, very hard and rough, the induration extending to the median line, where it ended

as a hard subtrigonal thickening is of great diagnostic value. In later cases this intervesicular plateau of induration becomes more and more pronounced but it is remarkable how long the upper portions of the seminal vesicles and vesical mucosa are free from invasion.

In a series of 111 cases many of them late and over 50 per cent associated with prostatic hypertrophy which necessarily modifies the symptoms and the progress of the disease there were 76 in which the first symptom was frequency of urination and in 48 cases difficulty of urination was also present. In 4 cases the onset was ushered in with hematuria and in 4 with complete retention of urine.

Pain was not infrequently an initial symptom and its location in these cases has been tabulated as follows:

	Cases.
Urinary tract (bladder or urethra)	16
Rectoperineal region	"
Inguinal and scrotal regions	2
Dorsal, sacral or gluteal regions	6
Lower extremities	3
Hypogastrium	1

In most of the cases in the above tabulation the pain was generally quite marked and sometimes very severe. Those cases in which only very slight burning was complained of were not included though several cases in which the burning was severe and amounted to a pain have been included. There was one patient in which irritability in the bladder was quite marked. One patient, aged sixty-four years was suddenly seized during urination with an excruciating pain which radiated from the bladder to the end of the penis and after that recurred frequently. In another case the onset symptom was pain in one groin and down the back of the thigh which his physician told him was rheumatic in character and gave him appropriate treatment for seven months when for the first time a very slight difficulty of urination was noticed. Only four weeks before admission were his urinary symptoms sufficient to call attention to his prostate by which time the entire prostate and seminal vesicles were involved in an extensive carcinomatous growth. In another case the first symptom which came on suddenly two and a half years before admission was a severe pain in the rectum which became continuous and grew steadily worse. Another patient had had only one symptom since the beginning, three months before sharp shooting pains in the left hip radiating down the left thigh to the knee and associated with numbness which extended to the foot. There was practically no urinary disturbance although the membranous urethra, prostate, seminal vesicles, pelvic glands, and rectum were involved in an extensive carcinomatous mass.

In 145 cases of benign hypertrophy the onset symptoms were as follows:

	Cases.
Frequency of urination	85
Difficulty of urination	76
Pain	25
Hematuria	"
Complete retention of urine	8
Incontinence of urine	8

the lateral lobes generally gives an elasticity to the prostate on deep pressure which is very deceptive. In these cases a small layer or nodule of cancer lying between the capsule and an hypertrophied lobe may be compressible on deep pressure. More delicate palpation, and particularly palpation upon a cystoscope in the urethra, will often show the real induration of the local carcinomatous area.

These localized areas of induration or nodulation should always be suspected and subjected to early perineal operation.

The case characterized by a small nodule of cancer in a prostate which was the seat of a chronic prostatitis of fifteen years' standing showed on rectal examination a prostate smooth, slightly indurated and not tender. The small nodule was not detected, and was only found accidentally when the stained sections of the tissue removed were examined.

The clinical examination of the seminal vesicles in these 12 early cases shows no definite invasion of these structures. In 1 case only was there an induration for a short distance in the region of one vesicle, but subsequent pathological examination (after radical operation) showed that the carcinoma had not penetrated the seminal vesicles as supposed but lay between it and the excised trigone, an area of cancer 1 cm. long being present. In the 2 other cases in which the radical operation was carried out only the juxtaprostatic ends of the seminal vesicles and vasa deferentia were invaded.

The vesical mucosa was normal in all of these cases, and no invasion of the trigone was present, as shown by the cystoscope and at operation.

The 6 cases in which no coexistent hypertrophy of the prostate was present showed, on cystoscopic examination, only a small median bar with no intravesical enlargement of the lateral lobes. In 1 case the median portion formed a small sessile lobe, and 1 case showed both a median bar and a slight right lateral enlargement.

The characteristic picture, then, in early cancer of the prostate is a small bar, unaccompanied by marked lateral intravesical enlargement.

In 1 case a carcinomatous constriction of the prostatic urethra was present, requiring dilatation before cystoscopy was possible, but there was no evidence of ulceration of the urethra in any case.

In later cases stricture of the prostatic urethra is not an uncommon finding, and is to be considered very suggestive of cancer.

Diagnosis—The diagnosis of early carcinoma of the prostate is principally based on the finding of great induration in a portion of the prostate, as shown by our cases. It may occur as a small nodule or lobule which may be prominent or imbedded in the prostatic tissue, but apparently almost always palpable per rectum. In later cases one whole lobe, or both lobes, may be involved, but the disease apparently remains circumscribed for a fairly long period, and the line of progress is upward, beneath the fascia of Denonvillier (which forms the posterior of the prostate and seminal vesicles, the ejaculatory ducts and the structures between the lower ends of the vasa deferentia and the bladder). Induration immediately above the prostate and easily palpable, with a finger in the rectum and a cystoscope in the urethra,

present more than ten years. None of these cases however were subjected to prostatectomy and we cannot therefore say with positiveness that the early symptoms were not due to benign obstruction to urination. In 23 operated cases in which there was no hypertrophy, the entire prostate being carcinomatous there was one in which difficulty and frequency of urination had been present for six years and severe pain for five years and other cases in which frequency and difficulty had been present for three years in 1 case two years in 2 cases one year in 3 cases, and six months in 1 case. These statistics are sufficient to show that the course of the disease is very variable in its duration some cases being extremely rapid and ending in death in less than a year but in the majority is of two or three years duration many cases extending over three or four years and a few cases over five years.

In the above tabulation it is noteworthy that pain came on much later than urinary obstruction. In only 13 cases of the 111 had pain been present over three years and in the majority of cases under eighteen months.

Catheter Life.—In 21 cases the patient had complete retention of urine and had used a catheter regularly for varying periods up to three years. In 13 cases the catheter had been used less than six months in 5 cases over a year and in 2 cases over two years. In 23 cases, although the patient was able to void urination was so slow difficult and frequent that the catheter was used one or more times daily. In 14 of these cases this has been present for less than six months in 3 cases between six months and a year in 2 cases over one year in 3 cases over two years and in 1 case five years. In 8 cases complete retention of urine occurred occasionally requiring catheterization but these patients did not use the catheter every day.

When the patient was admitted to the hospital the symptoms presented were as follows. Complete retention of urine and catheter life 19 cases. The number of times daily in which catheterization was necessary was as follows. Two times 2 cases three times 4 cases four times 2 cases five times 1 case six times 4 cases eight times 3 cases ten times 2 cases twenty times 1 case.

Incomplete retention of urine but catheter used 22 cases once daily, 2 cases twice daily 5 cases three times 4 cases four times 5 cases five times 3 cases six times 1 case seven times 1 case every few minutes 1 case.

In those cases in which urination was possible the difficulty of urination was great in 28 cases moderately difficult in 6 cases, slightly difficult in 5 cases.

The frequency of urination was very frequent (every few minutes to one hour) in 38 cases moderately frequent (about every two hours) in 7 cases slightly more frequent than normal in 13 cases. In 2 cases there was constant dribbling of urine associated with a large amount of residual urine.

In 12 of the 25 cases of benign hypertrophy in which pain was present there was only a slight burning in the urethra, and in 3 the pain was merely the discomfort produced by straining to void. In 1 case there was sharp pain which followed sudden stoppage of urine during micturition. In 9 cases calculi were present. In no case were there the symptoms of sciatica or severe pain in the hips, buttocks, thighs, or groins which have been seen in many of our cases of carcinoma.

Hematuria is shown to have been a more common initial symptom in benign hypertrophy than in carcinoma.

In conclusion it may be remarked that in the majority of cases the onset is much the same as that of benign hypertrophy, an increase in the frequency and difficulty of urination, which is often slowly progressive in character. Pain alone is a much more common symptom, and frequently remains for a long time the only symptom. In one remarkable case the first and only symptom complained of was pain in the legs.

In 60 cases which were studied by Motz the initial symptom was difficulty of urination in 38 cases, complete retention of urine in 8 cases, hematuria in 8 cases, neuralgia in 5 cases.

Duration and Course of Disease—Guyon recognized three forms: (1) those with a rapid course, in which the symptoms may have been present a very short time, (2) those following a subacute course, the disease having been present after the tenth or twelfth month, and (3) those following a very slow course with a duration of two or three and even as long as nine years. In 26 carefully studied cases Motz found that 40 per cent of the patients died within seven months after the initial symptoms, 7 lived over a year, and 6 for periods varying from two to ten years. In making this study we have prepared a table which shows the duration of various symptoms in our cases.

DURATION OF VARIOUS SYMPTOMS AT TIME OF ADMISSION OF PATIENT

	Difficulty of urination	Frequency of urination	Pain in urinary tract	Pain in rectum and perineum	Pain in groin and testicle	Pain in lower extremities	Pain in back	Pain in supra-pubic region
1 to 6 months	10	9	13	4		13	9	4
6 to 11 "	4	5	4	1	1		2	
12 to 17 "	14	12	4	2	3	3	3	2
18 to 23 "	3	3	1			1	2	
24 to 36 "	18	22	2	1	1	2	1	2
Over 3 years							1	
3 to 5 "	4	9		2				
6 to 10 "	6	7	2	1			1	
Over 10 "	2	1	2				1	

As shown in the above tabulation, symptoms were present in many cases for prolonged periods, the longest being twenty years, during which the patient had difficulty of urination and more or less frequent catheterization. There were 5 cases in which symptoms had been

less extensive carcinomatous infiltration in 1 case producing a continuous carcinomatous priapism

Loss of Weight.—In 30 cases considerable, in 11 cases moderate in 7 cases slight and in 13 cases no loss of weight was recorded. In 28 cases no mention was made on this point. Although in the later stages of the disease the emaciation was profound and rapid I have seen a great many cases with very extensive and long-standing carcinoma which were not associated with any loss of weight and the patient remained markedly active and strong

The following table shows the condition of the sexual powers in 47 cases present on admission as given by patients in cases in which a record has been made

Erections.	SEXUAL POWER.			
	Coitus normal.	Coitus impaired.	Coitus not attempted.	Coitus impossible.
Normal	8		~	
Diminished	1	4	3	1
Absent			4	24

While it is true that carcinoma has a much more decided effect upon the sexual powers than hypertrophy of the prostate as shown by the above table it is also true that in cases of extensive involvement of the prostate and seminal vesicles there may be no impairment of the sexual powers. One patient upon whom a radical operation was performed stated on admission that erections were normal coitus normal and indulged in about three times a week and that ejaculation though not quite so free as formerly was not accompanied by pain. In this case the entire prostate was carcinomatous and both seminal vesicles and vasa deferentia were filled with carcinomatous cells. In another case in which symptoms of urinary obstruction had been present for four years in which the seminal vesicles and prostate were extensively involved and the radical operation was performed microscopic examination showed both vasa deferentia and seminal vesicles completely filled with carcinoma cells the patient reported that intercourse was entirely satisfactory. In some cases the only complaint is that the amount of semen ejaculated was less than normal

Duration.—As shown in the statistics given above, cancer of the prostate (even when unaccompanied by hypertrophy) may be of slow growth and remain for a long period well confined within the capsule of the prostate. Several years may undoubtedly elapse before periprostatic structures, seminal vesicles and trigone are much invaded so that the chances for radical excision are often excellent

Physical Signs.—We have already recorded our findings in the early cases. Briefly stated induration is the most important diagnostic sign and should lead to suspicion if only a small area of the prostate is involved. This induration is generally very marked and often almost stony. In our earliest cases the area was so minute that it was not recognized clinically but in all these cases the region involved was near the posterior capsule. In one case the area of carcinoma was about one-half as big as a pea and about 4 mm. in diameter

Pain.—The location and the severity of the pain present on admission is graphically shown in the accompanying table

	Slight	Moderate	Severe
Urethra	4	4	10
Penis	3	4	11
Perineum	3	5	7
Bladder	4	2	9
Rectum	2	0	10
Groin	1	1	0
Testicle	3	0	3
Hip	2	3	4
Thigh	2	4	8
Leg	2	8	8
Foot	1	1	3
Lumbar	5	3	7
Sacral	2	2	5
Buttocks	0	4	1
Pubic	2	3	5
Renal colic	0	0	0

The regional pains above tabulated most frequently occurred in groups. Of these the genito-urinary was the most common, and was characterized by pain in the bladder, urethra and penis, especially during urination. The rectum and perineum were also grouped together, the pain there being generally due to pressure from the enlargement of the gland, which was often sufficient to greatly reduce the lumen of the rectum and render defecation difficult. The other groups of symptoms may be classed as referred rather than local. Among them were noticed three distinct groups. Those radiating to the groin and testicle, those radiating to the lower extremities, and those radiating to the back, sides, and buttocks. The explanation of these pains is probably the same as in cases of chronic prostatitis, a reference of painful stimuli to other nerves running into the same segment of the cord as the periprostatic nerves.

Hematuria —Hematuria was present at one time or another during the course of the disease in 16 cases. In 10 of these it had been intermittent and only once considerable in amount. In 3 cases the amount of blood present was moderate and in 6 slight. In 6 cases blood was continuously present, in 1 slight, in 2 moderate, and in 3 considerable in amount. Examination of the urine on admission showed blood in 8 cases, and in 6 of these it was very slight in amount, but in 3 cases it was quite considerable.

Hematuria seems to be more suggestive of vesical tumor, calculus, or a benign middle lobe. It is certainly not so commonly present as in cases of benign hypertrophy of the prostate, as in my series of 145 cases I found it present in 15 per cent. The absence of hematuria is due to the fact that carcinoma of the prostate does not invade the bladder except in a small proportion of cases, but is retrovesical and pelvic rather than intravesical. It is also interesting to note that there are no cases in this series in which hemorrhage from the penis occurred, although in 3 cases the anterior urethra was surrounded with more or

posterior limit. With the finger in the rectum, and while the cystoscope is in the urethra with the beak turned downward the cystoscopic diagnosis of subtrigonal infiltration is confirmed by the hard mass of tissue between finger and cystoscope.

A transverse plateau of induration above and continuous with the prostate and involving the region of both seminal vesicles the inter-vesicular and subtrigonal tissues is often encountered. If this has not progressed too far above the prostate the case may still be radically operable. But usually it is much too far advanced.

Enlarged glands which are rarely found except late are of little diagnostic value—when present the malignant nature is evidenced by the character of the prostate itself and the glands are usually so far out along the pelvic wall that hope of radical cure is gone.

In a series of 111 cases enlarged glands were found by rectal examination adjacent to the prostate in 3 near the seminal vesicles in 1 along the lateral wall of the pelvis in 13 and in the sacral fossa in 6 cases. In 22 cases enlarged glands of the groin were found and in 2 cases in the iliac fossa.

When we consider the very extensive enlargement of the prostate and seminal vesicles which was present in these cases it seems remarkable that the lymph glands were so seldom involved but our findings correspond to those of Kaufmann who discovered in 100 autopsies upon patients dying of carcinoma of the prostate only 27 cases in which there was involvement of the pelvic lymph glands. It shows the fact that one should not expect enlarged glands before making a diagnosis of carcinoma of the prostate.

Rectal Examination.—The condition of the prostate etc. at examination is shown thus

Size	Prostate.	Both.	Perineal reaction.	Left.	1 cent. anterior space.	Membranous urethra.
Slight enlargement	16	8	3	2	10	2
Moderate	27	19	3	3	10	8
Considerable	64	39	2	3	37	24
Indefinitely described	4					
Surface						
Smooth	32	7	1	1	5	
Rough	00	30	3	3	25	6
Not noted	10					
Consistency						
Soft	2					
Elastic	1	14	3	5	7	11
Slightly indurated		2	2	1	3	
Moderately indurated	6	3	7	4	2	24
Very hard	78	56	4	2	49	26
Stony	9	9			10	6
Mixed, soft and hard	10					

Consistence—In the above tabulation of the prostatic findings the one thing that stands out prominently is the induration. Whereas the large majority of benign prostatic hypertrophies are elastic or even

The remainder of the prostate was elastic, but this third-degree induration, immediately beneath the prostatic capsule, which however was smooth and uninvaded, was recognized as probably carcinoma. Perineal operation and frozen sections clinched the diagnosis. In a number of other cases small nodules, varying from 8 mm to 15 mm were found. These were usually smooth, ovoid, sharply demarcated from the surrounding tissues and compressible into it. In some cases it was impossible to differentiate between carcinoma and stone, and in all instances a roentgen-ray was taken to exclude calculus. In some cases, in which only a small nodule appeared in the posterior lobe, at radical operation the carcinoma was found to have spread more widely in a deeper layer. In the more advanced cases, however, the whole posterior surface presented a very hard feel which was often smooth and well defined laterally. In many cases there was a slight roughness, and in a few early and most late ones a markedly nodular condition.

This diagnostic induration is generally harder than in prostatitis or tuberculosis of the prostate and the suburethral portion is more uniformly involved. The induration is almost always of third degree—greater than is almost ever seen in a benign hypertrophy. In rare cases, however, an isolated lobule of adenomatous hypertrophy has broken through from the lateral into the posterior lobe, lies immediately beneath the capsule, and may be difficult to differentiate from carcinoma. In some cases, in fact, it is necessary to make the diagnosis at operation, after excising the nodule and obtaining a frozen section. The cut surface of adenoma is entirely different from that of carcinoma, so that naked eye diagnosis is usually possible, although occasionally frozen section may be required. In those cases in which the carcinoma consists of only a small nodule in one lobe, it is often safer to excise it completely and study the stained frozen section before completing the operation. In some of these cases I have carried out a hemi-prostatectomy, as will be shown farther on, but in most cases it is wiser to carry out the radical operation. In some cases, especially where prostatitis has also been present, diagnosis is very difficult, and an exploratory perineal operation, at which sections of the subcapsular indurated areas may be necessary before diagnosis can be made, should be done.

The progress of the cancerous invasion is usually into the tissues between the seminal vesicles and the bladder and characterized by an induration which is usually more marked than in seminal vesiculitis. Sometimes the seminal vesicles are not in themselves invaded and can be palpated as soft distended sacs behind the indurated area beneath the trigone. In some cases the carcinoma has invaded the bladder in the region of the trigone, which is then found elevated, but with the mucosa intact. The extent of its upward progress can often not be made out on rectal examination until cystoscopy is carried out. In such cases the cystoscope shows an elevated plateau in the anterior part of the trigone, and sometimes extending well back toward its

The *induration* usually found in carcinoma of the prostate is of a peculiar incompressible character entirely different from that seen in tuberculosis and chronic prostatitis and as shown above usually not associated with any areas of softness unless a portion of the prostate be still uninvaded or unless there be an elastic hypertrophied lobe beyond a thin shell of carcinoma. When the entire prostate has become involved the diagnosis is at once apparent. The prostate is usually more firmly fixed in its location by pericapsular adhesions (due to inflammatory infiltration as is often seen adjacent to carcinoma and not necessarily cancerous invasion). Where only a portion of the prostate is involved and especially when coexistent with hypertrophied lobules the diagnosis is often very difficult and in fact impossible but the presence of such an area of induration especially if of third degree should lead to a suspicion of carcinoma and careful investigation at operation with incision of the suspected area (if necessary) and perhaps stained frozen sections. In such cases the consent of the patient to a radical operation in case the disease should prove carcinomatous should be obtained beforehand. As noted above the enlargement was slight in 16 moderate in 27 and considerable in 64 cases. As a rule when the carcinoma has not spread beyond the prostate there is only a moderate amount of enlargement present and often the prostate is only slightly enlarged. In most of our early cases this was the condition present and not infrequently owing to the small size their physicians were apt to consider the prostate negative on rectal examination even when the disease had spread to the space between the seminal vesicles and bladder. The line of demarcation between the prostate and the extensive transverse plateau of induration above it is often impossible to outline and not infrequently the prostate is described as considerably larger than normal and at operation the enucleated lateral lobes are found to be very little enlarged.

The *surface* of the prostate as indicated above was smooth in 32 and rough in 69 cases. Under the head of rough we have included cases described as irregular with a nodule here and there as well as those in which marked roughness was everywhere present. One of the most surprising findings has been that the surface is remarkably smooth in many cases. This is due to the fact that the fascia of Denonvillier which extends from the triangular ligament upward beyond the seminal vesicles as a tense fascia closely applied to the posterior surface of the prostate in the anterior of its two layers, makes a firm barrier against invasion toward the rectum. In fact, this fascia remains itself free from invasion generally until late in the disease but although many of the cases are perfectly smooth when roughness is present it is usually so entirely different from anything seen in hypertrophy of the prostate that carcinoma should at once be suspected.

In our series of 145 cases of *benign hypertrophy* there was only 1 case which was rough and nodular and in 14 cases in which the smoothness of the posterior surface was distorted by the presence of one or more lobules which projected beyond the confines of the rest of the hyper-

soft, there is only 1 case of cancer which was described as elastic, and none were entirely soft (barring 2 cases spoken of below)

In our series of 145 cases of benign hypertrophy the prostate was described as soft in 56, firm in 45, moderately hard in 14, very hard in none, stony in none. The marked contrast is at once apparent, and it is only necessary, therefore, to say that whenever the prostate or only a portion of it is quite hard it should be viewed with suspicion.

The case in which the prostate was everywhere elastic was one in which the lateral and median lobes were considerably enlarged by benign hypertrophy and the carcinoma was confined to a small area (about 1 cm. in diameter) in the anterior commissure, which could not be palpated by rectum. In 2 cases the seminal vesicles were very hard and evidently markedly involved by cancer, but in the region of the prostate there was a very prominent, smooth, soft, almost fluctuating mass, oval in shape, and evidently hematoma or blood cyst beneath the posterior capsule. In neither of these cases was operation performed, but in another case in which a perineal prostatectomy was done a cyst 1 x 1.5 cm. in size, filled with brownish fluid, was found just beneath the capsule next to the cancer, and was, I believe, the same process (old hematoma) but of a smaller size.

It is the group of 10 cases described above as mixed, soft, and hard that are the most interesting, as it contains many in which the diagnosis was extremely difficult, and often not made except on the operating table and with the aid of stained frozen sections. In all but 2 of these 10 cases perineal operations were performed (radical 2, conservative 6), and the tissues have been carefully examined. In 6 of these benign hypertrophy was present along with cancer. In 2 of these one lobe of the prostate was soft and showed only a benign hypertrophy, but on the other side, which was hard, there was a layer of carcinoma between the capsule and the hypertrophied lateral lobe. In 3 cases the subcapsular "shell" of carcinoma was present also on the soft side, but was thin enough to transmit the elasticity of the hypertrophied lobe beneath.

In 1 case only one nodule of cancer (about 1 cm. in diameter) was found beneath the capsule on the left side. The rest of the prostate was composed of benign adenomatous spheroids.

In 2 cases in which the radical operation was done no benign adenomatous hypertrophy was present, the entire prostate being replaced by cancer. In both of these cases it is difficult to explain the comparative softness of one of the lobes which was noted on several careful examinations.

A review of these 10 cases seem to show that the coexistence of benign adenomatous hypertrophy may lead to a modification of the induration usually found in cancer of the prostate when the layer of the cancer between the posterior capsule and hypertrophied area is not too thick to transmit the elasticity of the hypertrophied lobe beneath. When no hypertrophy is present the prostate is almost always very hard in those portions of the prostate involved by cancer.

invades the soft tissues beneath the trigone adjacent to the ejaculatory ducts the lower ends of the vasa deferentia and seminal vesicles usually forming a small plateau of induration which in some cases occupies a breadth of 1 cm. on each side of the median line. In other cases it extends to the outer side of each vesicle thus forming a plateau continuous with the prostate and often difficult to distinguish from it. Further progress generally consists of involvement of the interior of one or both seminal vesicles and tissues between them and the bladder thus forming usually a bicornate mass of induration with a sharp concave upper border (determined by the lower limit of Douglas pouch of peritoneum). The posterior surface of these supraprostatic invasions is usually smooth (on account of the strong fascia covering them) but not infrequently they are irregular and nodular. The induration like that of the prostate is usually very great often of stony hardness and the whole mass is fixed by adhesions to the pelvic wall. When a portion or all of the seminal vesicles escapes invasion it may form a soft somewhat elastic layer between the rectum and the subtrigonal infiltration and lead to mistake as in one of my cases in which the radical operation was performed on the assumption that the disease had not progressed far above the prostate. In this case although the upper portions of the seminal vesicles were healthy the disease had reached the peritoneum by traveling in the space between them and the bladder. A more careful examination especially making use of the cystoscope in the bladder and the finger in the rectum should have demonstrated this.

Membranous Urethra.—The tabulation (p. 847) also shows a considerable involvement of the membranous urethra and here again the figures are probably less than the truth because in many of the early cases the records are not complete in this respect. As shown here however there was more or less thickening of the membranous urethra in 32 cases and in 61 cases distinct induration often of stony hardness. In most of these cases the invasion was continuous with that of the prostate and simply surrounded the membranous urethra. In no cases was there any evidence of ulceration into the membranous urethra which like the prostatic urethra very seldom becomes ulcerated in cases of carcinoma.

In a few cases the disease spread to the perineum from the membranous urethra involving the fascia back of the triangular ligament on one or both sides this was recorded in 5 cases. In only 3 cases did the disease extend in front of the triangular ligament and in these the corpus spongiosum had become infiltrated. In one interesting case the corpora cavernosa were apparently completely replaced by carcinomatous infiltration which extended up to the glans penis thus producing a constant erection of almost complete character which was due entirely to the carcinoma. In this case as well as the two mentioned above there was no ulceration of the urethra and no hematuria.

Rectum.—As remarked above the two layers of the aponeurosis of Dénonvillier act as a powerful barrier against backward invasion of carcinoma of the prostate and this is abundantly proved by the fact that among these 111 cases there is only 1 in which the mucous mem-

trophied prostate, in some cases having broken through the posterior capsule, generally at the upper end on one or both sides, and thus projecting into the region of the seminal vesicles, and occasionally toward the apex of the prostate, where the lobule sometimes encroached upon the rectum. In these cases, however, the lobule was smooth and generally somewhat elastic, and entirely different in its appearance from the indurated areas seen in our cases of early carcinoma. In some cases of benign hypertrophy with a history of suppurative conditions, adhesions, and irregular areas of infiltration suggested carcinoma strongly, and in one such case the diagnosis of carcinoma was held until after a suprapubic drainage the prostatitis disappeared, and along with it the posterior surface of the prostate became smooth and elastic, so that the benign character of the enlargement was at once evident and demonstrated by perineal prostatectomy.

Seminal Vesicles — As shown in the tabulation (p 847) the seminal vesicles were frequently involved. The seminal vesicles, one or both, were indurated in 88 cases and more or less enlarged in 82 cases. It is probable that both of these figures should be a little larger, as the seminal vesicles were in some cases difficult to reach, owing to the thickness of the perineum, the fatness of the patient or the large size of the prostate. Only 14 cases are recorded in which both seminal vesicles were normal in consistence and size, and therefore probably not involved by the carcinoma. These 14 cases are of considerable interest. In all but 2 cases the diagnosis of carcinoma was confirmed by study of tissues removed at operation (radical excision 3, perineal prostatectomy 9). In 2 of the cases, in which the radical operation was performed, although the seminal vesicles were free from invasion, there was a small area of carcinoma just above the prostate, beneath the anterior part of the trigone and adjacent to the lower end of the seminal vesicles. In the other case the disease had not spread beyond the upper limit of the prostate. In all 3 of these cases the diagnosis was made before operation. In 2 cases the malignant nature of the disease was not recognized either before or during the operation (1 suprapubic and 1 perineal prostatectomy), but the microscope subsequently showed carcinoma. In both of these cases the disease had not spread above the prostate, and a radical operation should have given good results.

As noted in the table (p 847) there were 18 cases in which only 1 of the seminal vesicles was found to be involved, and in view of the cases of apparent cure, detailed above it, would seem probable that in several of these cases the upper portion of the vesicle was free from disease and that a radical operation might have been performed with success.

Intervesicular Space — As noted in the (p 847) table the space between the seminal vesicles above the prostate was involved in a great many cases, and had careful notes in regard to this region been made in some of the cases seen several years ago, it is probable that the percentage of involvements of this region would be even greater than that of the seminal vesicles. As a rule, when the disease spreads above the prostate it

invades the soft tissues beneath the trigone adjacent to the ejaculatory ducts the lower ends of the vasa deferentia and seminal vesicles usually forming a small plateau of induration which in some cases occupies a breadth of 1 cm. on each side of the median line. In other cases it extends to the outer side of each vesicle, thus forming a plateau continuous with the prostate, and often difficult to distinguish from it. Further progress generally consists of involvement of the interior of one or both seminal vesicles and tissues between them and the bladder thus forming usually a bicornate mass of induration with a sharp concave upper border (determined by the lower limit of Douglas pouch of peritoneum). The posterior surface of these supraprostatic invasions is usually smooth (on account of the strong fascia covering them) but not infrequently they are irregular and nodular. The induration like that of the prostate is usually very great often of stony hardness and the whole mass is fixed by adhesions to the pelvic wall. When a portion or all of the seminal vesicles escapes invasion it may form a soft somewhat elastic layer between the rectum and the subtrigonal infiltration and lead to mistake as in one of my cases in which the radical operation was performed on the assumption that the disease had not progressed far above the prostate. In this case although the upper portions of the seminal vesicles were healthy the disease had reached the peritoneum by traveling in the space between them and the bladder. A more careful examination especially making use of the cystoscope in the bladder and the finger in the rectum should have demonstrated this.

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brane of the rectum was invaded, and 13 cases in which the prostate was adherent to the rectum. In many of the later cases, however, the adhesions were probably only of such inflammatory character as is often seen adjacent to malignant growths and do not necessarily mean invasion. While the aponeurosis of Denonvillier protects the rectum from invasion it does not prevent constriction of its lumen either by the bulk of the carcinomatous mass or by constriction in the region of the seminal vesicles through the development of a ring of carcinoma around the rectum. This was present in only a few cases when first examined, but from letters I have received concerning the progress of the disease I am satisfied that it has occurred not infrequently later in the disease. In fact, it forms one of the most troublesome later complications, leading to a partial or almost complete stricture of the rectum, severe constipation, and occasionally requiring colostomy.

The Bladder—The conditions present in the bladder have been studied in various ways—in 49 cases by cystoscopy, in 6 cases by suprapubic cystotomy, in 21 cases by perineal prostatectomy, and in 12 cases by autopsy. In not all cases were the notes full in every respect, so that the figures in the tabulation given below are not always complete. They show, however, very forcibly the fact that intravesical tumor growth is extremely rare and only occurs very late in the disease, and then in only a small percentage of cases, that the trigone is often thickened, and that the changes at the prostatic orifice consists usually in thickening or possibly slight rounding of the median portion. In those cases in which considerable enlargement of the lateral lobes was found it was probably due, in all cases, to a coexistent adenomatous hypertrophy.

CONDITIONS WITHIN THE BLADDER

	By cystoscopy	Suprapubic opera- tive examination	Perineal operative examination
Median portion			
Normal	1	3	
Slight bar	23		8
Considerable bar	15	1	6
Rounded lobe	5	2	3
Right lateral			
Normal	16	3	
Slight	25	2	17
Considerable	5		2
Left lateral			
Normal	17	3	
Slight	22	2	17
Considerable	7		2
Trigone			
Negative	13	2	
Thickened	17	3	8
Ulcerated			
Tumor			
Ureteral ridges			
Negative	20	3	
Elevated	15	1	
Ulcerated			
Tumor	2		
Rest of bladder			
Negative	21	4	16
Ulcerated	1		
Tumor	1	1	

In the 12 autopsies of which we have careful examinations there were only 2 in which the disease had spread into the bladder in the shape of a tumor or ulcer. In both of these cases suprapubic cystotomies had been performed several months before and although the base of the bladder was found invaded there was no ulceration or any form of intravesical tumor.

As a result of our clinical studies we feel justified in saying that when no hypertrophy is present the enlargement of the prostate in cancer is generally not great; that the growth is almost invariably upward into the space between the seminal vesicles and around the vasa deferentia beneath the trigone; that the changes at the vesical orifice consist usually in a thickening of the median portion of the prostate, with sclerotic condition of the internal sphincter (making a urethral orifice which is difficult to dilate) and that in some cases the median portion is in the shape of a moderately thickened bar but rarely a rounded intravesical lobe; that the trigone very frequently becomes thickened and sometimes considerably elevated from infiltration but that the mucous membrane everywhere (bladder and urethra) preserves its integrity wonderfully; that it rarely becomes ulcerated, and then only very late in the disease.

Structure of the prostatic urethra was discovered in 8 cases and probably existed in others. In only 1 case was it impermeable to filiforms and all other instruments. Most often it was merely a contracture through which small straight instruments (Nélaton catheters) could be passed but impermeable to Condé catheters and cystoscopes.

Suburethral Thickening—The condition found between the cystoscope in the bladder and the index finger in the rectum is a very important diagnostic sign. An invasion of the posterior commissure of the prostate leads to considerable thickening and induration and when examination is made with the finger in the rectum and cystoscope in the urethra an increase in the thickness is made out; it is often impossible to feel the instrument anywhere along the urethra and particularly in the region of the median portion. If the disease has progressed above the upper end of the prostate thus forming an inter-vesicular plateau it is usually impossible to feel the beak of the instrument in the bladder. This condition is entirely different from that found in benign hypertrophy in which it is usually possible to palpate the shaft of the instrument through the posterior commissure (which is usually not much increased in size until the median portion of the prostate just beneath the vesical orifice is reached) and it is very rare to find even in the median portion a marked induration in benign hypertrophy and the beak of the instrument can generally be felt through the bladder unless the enlargement of the median portion is considerable.

Examination of Patient.—It is presumed that an adequate history has been taken. In this one should describe when changes in micturition occurred what the initial symptoms were hesitancy difficulty small stream interrupted micturition passage of blood concomitant

pain, increased frequency, etc. Careful questioning as to referred pains in back, sacroiliac regions, buttocks, hips, thighs and legs, symptoms suggesting neuralgia and neuritis, edema of regions below the prostate, difficulty in defecation, ribbon-like feces, admixture with blood, etc., loss of weight, malaise, symptoms of early uremia, and other items of interest in all cases of urinary obstruction, which may point to impairment of kidneys, infection, cardiovascular disease, etc. The progress in the symptoms, from their onset until admission to the clinic, should be carefully noted, especially as regards the occurrence of complete retention, catheterizations, infections resulting therefrom, gradual development of renal impairment, and cardiovascular disease.

The patient usually appears at the doctor's office complaining of urinary difficulty, and local examination is first performed. After noting the condition of the external genitalia and the glands, making a special search for glands, the patient should be instructed to void, generally after cleansing the glans and urethra to obtain cultures.

On *rectal examination* a careful chart of the outlines of the prostate should be made, and also a cross-section. Not infrequently the prostate will be very little larger than normal, with the usual outlines of prostate, seminal vesicles, vasa deferentia and membranous urethra, all of which are carefully marked on the chart. If any irregularities in form are present, nodules, single or multiple, should be indicated with their induration, as well as that of other parts of the prostate. Phleboliths and calculi are generally marked as of fourth degree, or solid black. Carcinoma is usually of third degree, and indicated by three different lines of marking or cross-hatching. The extent of the induration into the region of the vasa or seminal vesicles, or the tissues around them, or downward along the urethra or externally beyond the limits of the capsule, or posteriorly toward the rectum, are carefully noted on the chart. It is usually possible, on simple rectal examination, to make the diagnosis, so that instrumentation may not be necessary, but in many cases cystoscopy should be carried out.

Cystoscopy—The patient empties his bladder as completely as possible before mounting the table. After a thorough cleansing with soap, water, strong antiseptics externally and mild antiseptics within the urethra, the genitalia are covered with a perforated towel. A sound is often inserted to see whether the posterior urethra is markedly contracted. Introduction of sounds up to No. 24 or 26-F will often make the passage of a cystoscope easier. A posterior cysto-urethroscope should usually be employed in order to study the urethra after the bladder has been carefully surveyed. In studying the bladder, it is important to examine the trigone carefully to see if there is any sub-trigonal infiltration, resulting in elevation and its extent. If it is evident only a short distance beyond the prostatic orifice, the radical operation may yet be performed successfully. The presence of enlarged lateral and median lobes, indicating definite hypertrophy, must not be taken as an indication that carcinoma may not also be present. When alone, the changes at the vesical orifice produced by carcinoma

are often no more than a slight median bar or small rounded elevation usually covered by smooth mucous membrane. It is extremely rare to find the mucous membrane of the bladder or urethra ulcerated or replaced by carcinomatous growths except late in the disease.

Having studied the bladder the posterior cystoscope is drawn out into the urethra where a further study of the median and lateral enlargements is made. Even with the presence of extensive carcinoma adjacent the urethra is usually smooth. In very rare instances will a carcinomatous growth in the form of capillary carcinoma be seen. Before withdrawing the cystoscope the beak should be turned downward the finger inserted into the rectum and a careful estimate of the thickness and consistence of the tissues in the region of the trigone, subcervical and suburethral portions of the prostate made. The confirmation as to induration of lateral nodules or larger masses can also be obtained in this way. In fact this digito-cystoscopic examination is extremely important in the diagnosis of early cases and as noted above is particularly valuable to find whether the radical operation offers a chance of cure.

Cystoscopy in these cases is apt to be followed by much soreness and swelling of the urethra perhaps by complete retention of urine. The patient should therefore usually be in the hospital as catheterization may be necessary.

If a large amount of residual urine (over 150 cc.) has been obtained a retention catheter should be employed. A catheter is also a requisite in obtaining a phthalein test.

Usually before carrying out so painful a procedure as cystoscopy in these cases a careful study of the cardiovascular system should be made. In the aged and severe cases an internist thoroughly trained in urological cases should be called in to define accurately the conditions present and prescribe preoperative treatment.

Diagnosis.—In the preceding paragraphs the groundwork for diagnosis has already been thoroughly discussed. It is simply necessary here to state that the presence of an area of third degree induration even if extremely small should be regarded with suspicion if the roentgen ray has shown that the induration is not a calculus. As shown by our studies many years ago and confirmed recently by the publications of Rich and Moore the transverse lamella of prostatic tissue immediately beneath the posterior capsule and separated from the lateral lobes by a layer of intraprostatic fibrous tissue is the site in which carcinoma first appears in a large percentage of cases. This portion of the prostate usually called the posterior lobe is completely palpable by rectum so that any area of induration even small should be detected and noted on the chart. If very hard "of third-degree induration" carcinoma should be suspected even though the prostate be no larger than normal and the patient have no positive urinary symptoms. In 3 cases in which we had the opportunity of examining patients who came for a general survey of their condition we have discovered a small carcinomatous nodule in the prostate which gave

pain, increased frequency, etc. Careful questioning as to referred pains in back, sacroiliac regions, buttocks, hips, thighs and legs, symptoms suggesting neuralgia and neuritis, edema of regions below the prostate, difficulty in defecation, ribbon-like feces, admixture with blood, etc., loss of weight, malaise, symptoms of early uremia, and other items of interest in all cases of urinary obstruction, which may point to impairment of kidneys infection, cardiovascular disease, etc. The progress in the symptoms, from their onset until admission to the clinic, should be carefully noted, especially as regards the occurrence of complete retention catheterizations, infections resulting therefrom, gradual development of renal impairment and cardiovascular disease.

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comprise the following (this was my record when the manuscript for the second edition was prepared later in this chapter a study of 30 cases is presented)

	Cases
I Radical operation	10
II Subtotal, excision	4
III Conservative (partial) perineal prostatectomy	71
IV Suprapubic prostatectomy	2
V Bottini electrocautery operation	5
VI Castration	2
VII Suprapubic drainage	12
VIII Perineal drainage	2
IX Treated by catheterization	30
X. No catheter or operative treatment	20
Total cases studied	179

Anesthesia—With the progress of time we have discovered that spinal anesthesia is in many ways much the most satisfactory. We now employ pantocain and find that 20 mg. of the crystals dissolved in the spinal fluid is sufficient for even so long a procedure as the radical operation. The advantage of pantocain is that it is usually accompanied by much less lowering of the blood pressure which if it occurs can be easily handled by intravenous injections of adrenalin or ephedrin. No pain is usually experienced until the deepest portion of the operation is reached—the isolation, clamping and ligation of the vascular pedicles of the seminal vesicles. In some cases it is advisable to make a local injection of novocain at this point. This usually lasts sufficiently long to complete the anastomosis and wound closure.

If the patient is aged or very weak, anemic or otherwise not a good risk, arrangements may be made beforehand for the administration of continuous intravenous 5 per cent glucose solution or provisions made to have a blood donor in case of shock. In those patients who are in fairly good condition there is usually no shock and often the bleeding is much less than in an ordinary prostatectomy. One should be prepared to meet emergencies and careful preoperative preparation and observation of the patient's condition made from time to time during the operation.

I. Technique of the Radical Operation—Described first in the *Johns Hopkins Hospital Bulletin* October 1900. Since then no occasion to change the technique has arisen.

The patient is placed in the exaggerated lithotomy position and an inverted U perineal incision made as in the operation for simple hypertrophy of the prostate, the successive steps of which are followed until the tractor has been inserted through a urethrotomy wound of the membranous urethra and the posterior surface of the prostate has been exposed largely by blunt dissection. If there is then any doubt in the mind of the operator as to the malignant nature of the disease an incision is made through the capsule and a section removed for examination, frozen sections being made if necessary to establish the diagnosis, when either the simple prostatectomy for hypertrophy or

absolutely no symptoms, micturition being entirely normal. In order to exclude calculus a roentgen-ray should always be taken, the rays being directed down the pelvic strait so as to throw the prostatic shadow well within the pelvis.

In some instances the urologist may hesitate to make a positive diagnosis, even after the thorough examinations, as above stated. In such a case it is of great importance that perineal exposure of the prostate be made, so that the hard nodule may be seen and palpated directly. If such a nodule is thus found to be of marked induration, the diagnosis of carcinoma can be made without hesitation. If small, and located well to one side, hemiprostectomy may be carried out in such cases.

After having seen and palpated the suspicious nodule, the operator may still hesitate in his diagnosis. He can then excise within a large area of tissue the suspected nodule, incise it, and examine the cut surface. As a rule, the absence of bulging, the marked induration, the general yellowish appearance, accentuated by deeper yellowish dots and lines, makes the diagnosis certain without microscopic study. If, however, one is still uncertain, stained, frozen sections are made and studied by an expert on the pathology of the prostate. In some instances where the indurated area is much larger and the diagnosis, after inspection and palpation uncertain, one may simply incise deeply into the tissues, inspect the surface, and if necessary, wait for frozen sections, as above described.

Having decided that the condition is carcinoma, it is next necessary to determine accurately the extent to which the disease has progressed, particularly downward, towards the membranous urethra and tissues adjacent to the apex of the prostate laterally, and also in the direction of the seminal vesicles. This, however, constitutes operative examination, and will be referred to later on.

Summary—An area of very marked induration, even extremely small, in a prostate otherwise apparently normal, or occurring with evident benign hypertrophy, must be suspected. The presence of calculi should be ruled out by roentgen-ray. It may be necessary to have the aid of a cystoscope, and a finger in the rectum. If the diagnosis be carcinoma, a perineal operation to obtain a radical cure should be performed. If the diagnosis is not positive, but carcinoma suspected, even though there be no obstructive symptoms or pain, a perineal operation should be done to expose the prostate to view, at which time the suspicious area can be seen, palpated, incised, excised and even frozen sections made. The splendid results of radical surgery, given in detail later on, make it obligatory that no procrastination occur, and that immediate perineal operation be carried out, as above stated.

Treatment—There is such a wide variety of opinion as to the proper treatment of cancer of the prostate that it seems necessary to furnish here as complete a statistical study as possible. I will first give my own experience and then records from the literature. My own cases

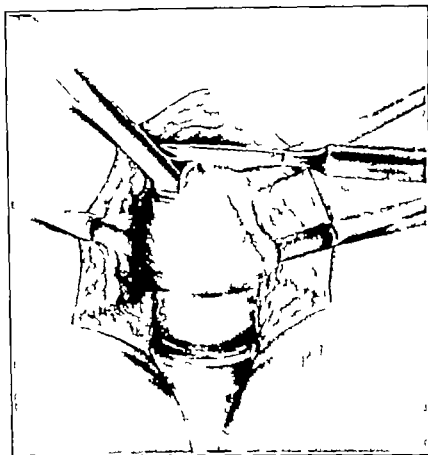


FIG. 400 —Division of membranous urethra.

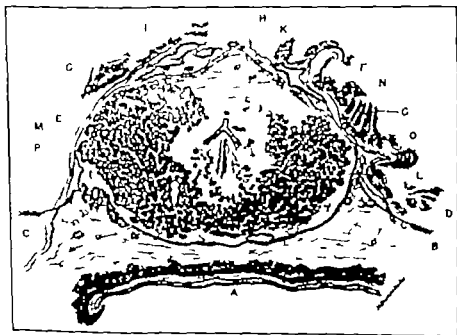


FIG. 401 —Transverse section of prostate and rectum. Arrows indicate points of beginning dissection beneath anterior prostatic fascia.

the radical operation for cancer can be performed as the case requires. In the case of cancer the next step after exposing the posterior surface of the prostate is to follow the fascia of Denonvillier upward and expose the posterior surface of the seminal vesicles as much as possible by blunt dissection. It is important here to carry the dissection along the lateral surface of the gland, hugging the capsule, and passing between it and the anterolateral pelvic fascia shown in Fig. 489. By elevating this fascia carefully from the anterolateral surfaces of the prostate the nerves and rich blood supply of this region are avoided (Figs. 492 and 493). Then the membranous urethra is divided in

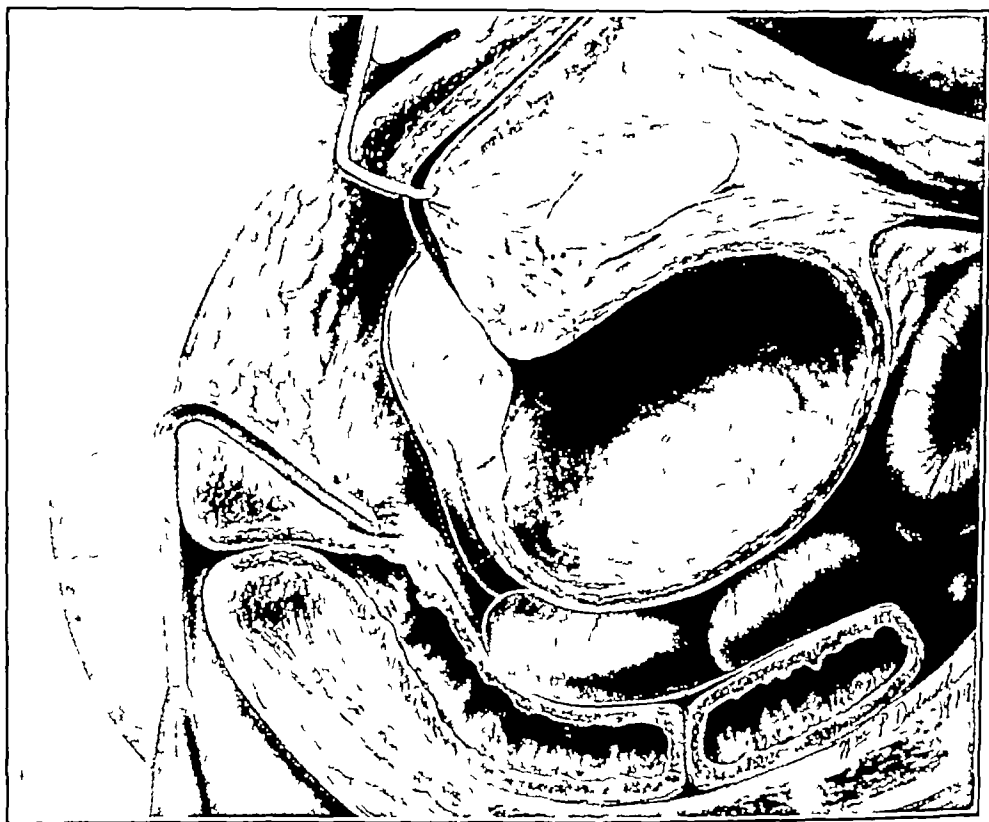


FIG. 489 —Longitudinal section of body, showing the line of excision to be carried out in radical operation for carcinoma of the prostate. The posterior surface of the prostate has been exposed through a perineal incision.

front of the tractor, as shown in Fig. 490. The handle of the tractor is then depressed markedly and the fascia elevated, the operator hugging the anterior surface of the prostate, efforts having previously been made to push away the anterior plexus of veins by blunt dissection. By thus going between the lateral periprostatic fascia and the prostate it is possible to avoid much hemorrhage. Hemorrhage should be controlled as much as possible by ligatures and then by gauze packs, which should be held tightly against the posterior surface of the pubes and the triangular ligament by means of a retractor. The seminal vesicles should be freed further.

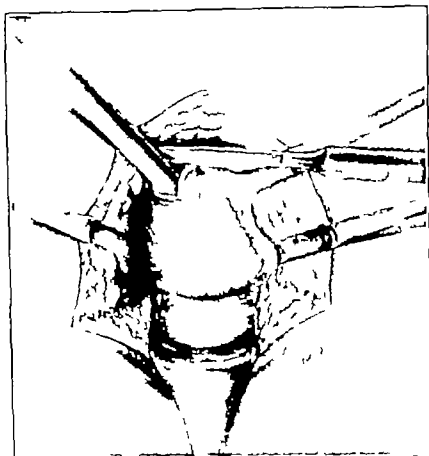


FIG. 490.—Division of membranous urethra.

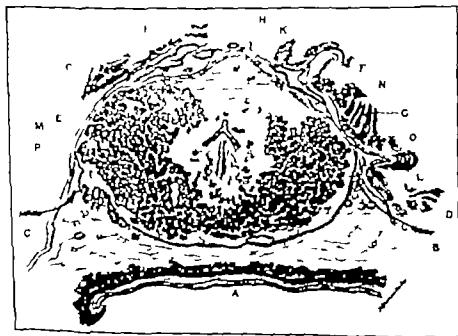


FIG. 491.—Transverse section of prostate and rectum. Arrows indicate points of beginning dissection beneath anterior prostatic fascia.

The prostate is drawn outward as far as possible, thus exposing the anterior surface of the bladder, which should be punctured, as shown in Fig 494, just above the prostatovesical junction. This wound is now enlarged on each side by scissors, the line of division being close to

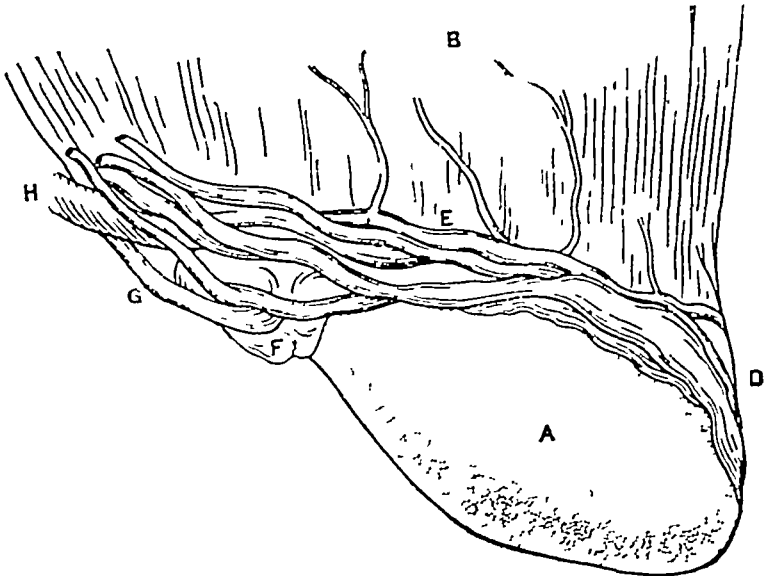


FIG 492 —Prostatic plexus of veins, side view A, prostate, B, bladder

the prostatovesical juncture, until the trigone is exposed, as shown in Fig 495. With the scalpel a curved incision is made across the trigone, thus leaving the upper angles of the trigone intact, and being careful

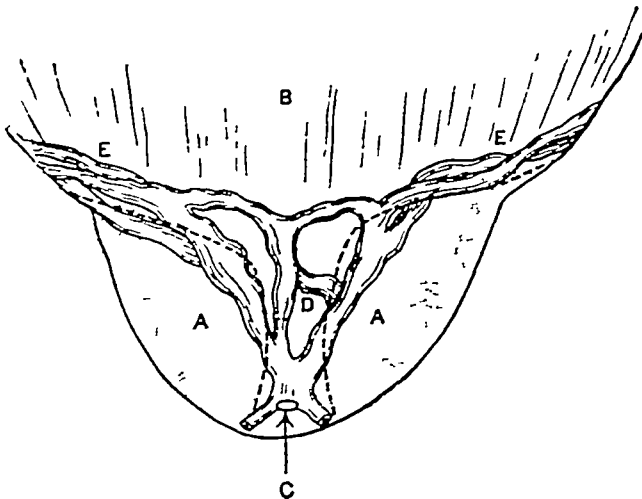


FIG 493 —Prostatic plexus of veins, anterior view

to do no injury to the ureters. By blunt dissection the bladder is pushed upward, the seminal vesicles are then exposed, as shown in Fig 496, and the vasa deferentia picked up with a blunt hook and divided with scissors as high up as possible. (In doing this it should

be remembered that the vasa deferentia pass around the lower end of the ureters.) The deeper attachments of the seminal vesicles are then freed and the mass consisting of the prostate urethra cuff of the bladder seminal vesicles and about 3 cm of the vasa deferentia is removed in one piece (Figs 497 and 498). Hemorrhage is again encountered in the last step above described owing to the fact that

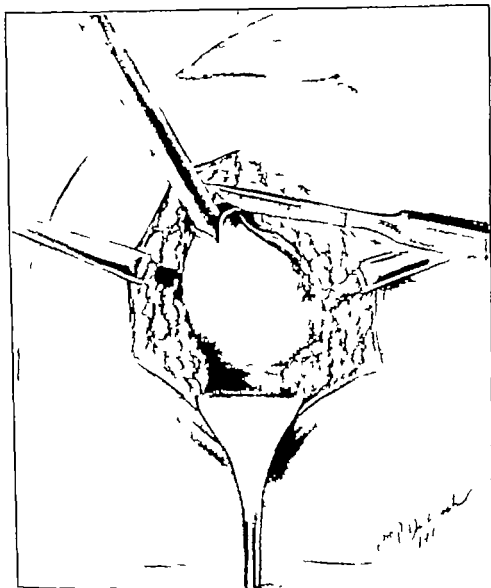


FIG 494 —Incision into bladder just above prostatovesical juncture

the prostatic plexus of veins which pass up along each side of the prostate is closely attached to the lateral border of the seminal vesicle but this can easily be controlled by ligatures or long clamps. The bleeding which comes from the vesical wound is easily controlled by the subsequent sutures which are placed so as to anastomose the bladder (Fig 499) with the membranous urethra and completely close the

vesical wound This is easily accomplished, as shown in Fig 500 As seen here the anterior wall of the bladder is drawn down and fastened to the stump of the membranous urethra by means of interrupted chromicized catgut sutures After forming the anastomosis with the urethra a considerable vesical wound is left posteriorly, but it is easily closed by a continuous chromicized catgut suture (Fig 501) A retained rubber catheter, which should be inserted before the vesico-urethral anastomosis is made, is fastened to the glans penis with adhesive plaster After placing light gauze packing in the depths of

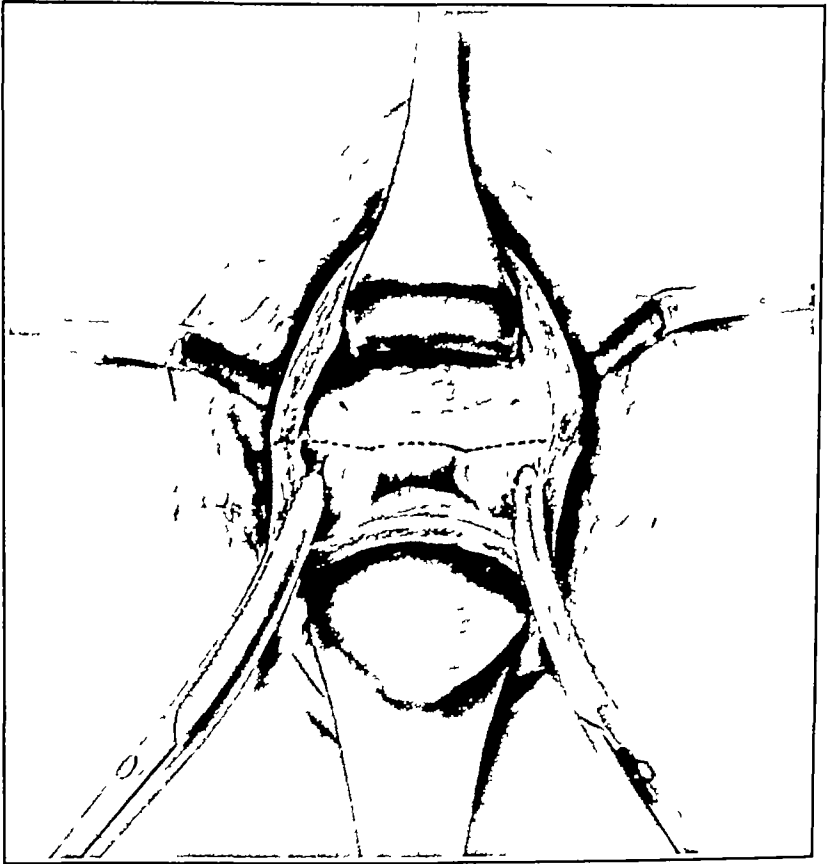


FIG 495 —Bladder opened Dotted line shows site of incision across trigone, below ureters

the wound the levator ani muscles are approximated with two or three interrupted sutures of catgut, so as to protect the rectum against pressure from gauze, and the external wound is almost completely closed with interrupted sutures of catgut In some instances I found it difficult to place ligatures around hemostatic clamps which were deeply placed, and have therefore not removed the clamps but allowed them to emerge with the gauze packing from the anterior angle of the wound (they were removed twenty-four hours later) If careful attention has been given to the prevention of hemorrhage and an

infusion has been begun early in the operation there should be little or no shock.

The treatment during convalescence is very similar to that employed after perineal prostatectomy viz. water in abundance urotropin the patient allowed to sit up as soon as possible daily irrigations of the bladder with small amounts of boric acid solution not more than 30 cc being injected at a time. The gauze packs are removed in two or three days and the urethral catheter in a week. No difficulty is experienced in getting a good approximation and wound healing and

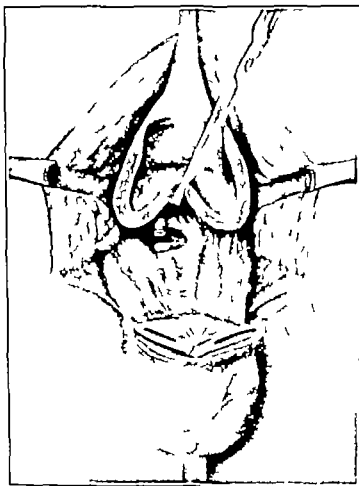


FIG. 406 — Seminal vesicles and vasa exposed, previous to division of vasa and removal of seminal vesicles and prostate.

little or no stricture formation has been encountered at the point of vesico-urethral anastomosis. Sounding is not necessary. None of my patients have had persistent fistulae (see literature 12 13 14 15 16 17 18 19).

Analysis of the First 10 Cases in which the Radical Operation was Performed — The ages of the patients were seventy sixty-four sixty-five, sixty-four seventy-five sixty-eight sixty-nine seventy-seven seventy and fifty-eight years respectively and symptoms had been

present eleven months, three years, four years, one year, eight months, one year, eight months, two years, three years, and two and a half years respectively. Physicians had been consulted and treatment given eight months before in one case, and seven months before in another. In both of these cases an osteopath was employed who gave prostatic massage, thus losing valuable time. One patient consulted a physician for prostatic trouble two and a half years before. One case was subjected to a Bottini operation six months before admission. In all cases sufficient symptoms were present to warrant rectal examination by which diagnosis could have been made long before the patient applied for treatment with us.

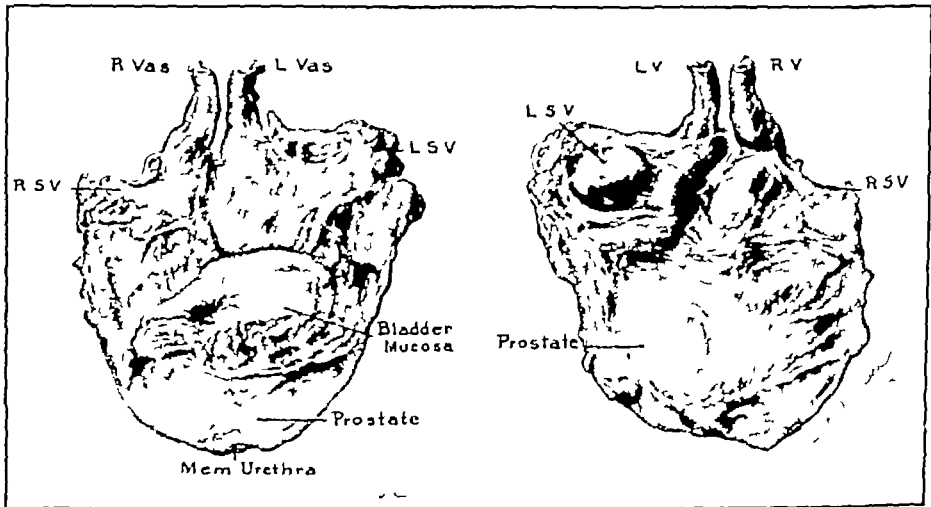


FIG 497—Anterior view, showing area of bladder mucosa removed

FIG 498—Posterior view of prostate, seminal vesicles and vasa deferentia removed in radical operation

The initial symptoms were difficulty and frequency of urination in all cases except Case I and Case VII, in which the first symptom was pain in the urethra. Four patients (Cases II, IV, VI and VIII) had never suffered any pain. In 4 cases pain, either local or referred, was a prominent symptom. One patient had pain only on ejaculation, and another only slight pain in the buttock. On admission, urination was extremely frequent and difficulty in 5 cases. In 1 case a catheter was used twice daily. In 3 cases there was little difficulty, and in 2 cases the patient only got up once at night to urinate, and only 2 patients had had hematuria.

The prostate was described as considerably enlarged in 4 cases, moderately in 3 cases, and slightly enlarged in 3 cases. There was marked induration in all cases, involving the whole prostate in 4 cases. In Case IV the marked induration was confined to one-half of the prostate, the other one-half being very slightly indurated.

In 3 cases (Cases VII, VIII and X) the carcinoma consisted of one very hard circumscribed mass or lobule, which in each case projected

from the general level of the left lateral lobe but was still well encapsulated. The rest of the prostate showed adenomatous hypertrophy.

The seminal vesicles were found on rectal examination to be free from infiltration or induration in 5 cases. An area of induration between the seminal vesicles was present in 1 case. The catheter

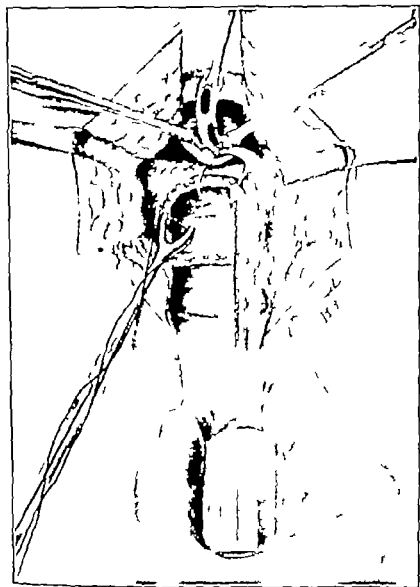


FIG. 499.—Use of boomerang needle holder in making anastomosis between bladder and the membranous urethra.

showed 400, 300, 500, 400, 80, 600, 60, 160, 20 and 10 cc residual urine respectively.

The cystoscope showed a slight elevation of the median portion in 5 cases; in 3 cases a small definitely rounded median lobe with a shallow cleft on each side; and in 1 case a large median lobe.

The lateral lobes were scarcely at all enlarged intravesically in all

present eleven months, three years, four years, one year, eight months, one year, eight months, two years, three years, and two and a half years respectively. Physicians had been consulted and treatment given eight months before in one case, and seven months before in another. In both of these cases an osteopath was employed who gave prostatic massage, thus losing valuable time. One patient consulted a physician for prostatic trouble two and a half years before. One case was subjected to a Bottini operation six months before admission. In all cases sufficient symptoms were present to warrant rectal examination by which diagnosis could have been made long before the patient applied for treatment with us.

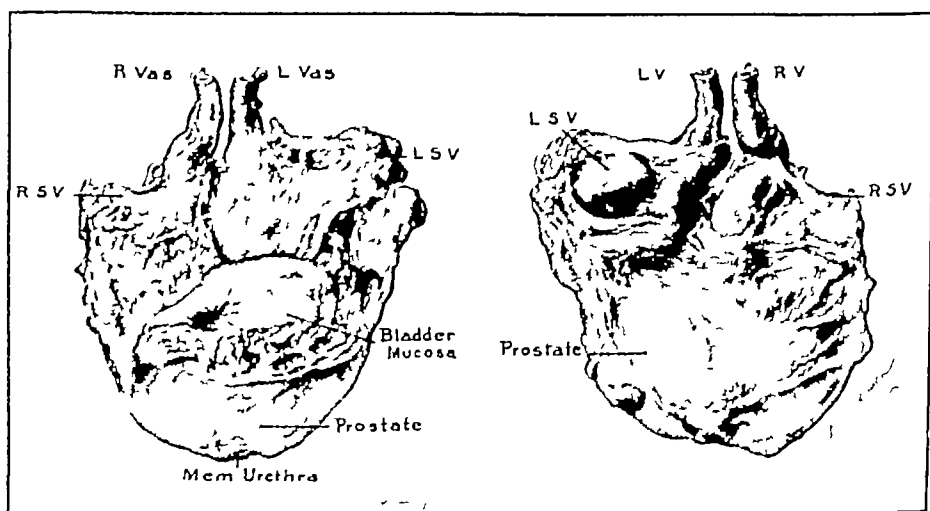


FIG. 197 —Anterior view, showing area of bladder mucosa removed

FIG. 198 —Posterior view of prostate, seminal vesicles and vasa deferentia removed in radical operation

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In 3 cases (Cases VII, VIII and X) the carcinoma consisted of one very hard circumscribed mass or lobule, which in each case projected

of shock) autopsy showed extensive carcinoma of the peritoneum and retroperitoneal glands although the bladder and seminal vesicles were free from invasion. In Case I the patient died nine months after the operation as a result of traumatism and infection caused by an attempt to remove a stone adherent to a silk suture. Autopsy showed a very small area of recurrence 1 cm. in diameter back of the bladder. In



FIG. 501.—Longitudinal section, showing result of suture of bladder to urethra.

Case III the patient lived over three years in comfort, but autopsy showed metastases in various parts of the body, the bladder and urethra, however being free from ulceration. In Case II in which the patient died six weeks after the operation from ascending renal infection as a result of the intentional but injudicious division of the two ureters, extremely careful examination of all the pelvic tissues at autopsy with numerous sections taken for microscopic study failed

cases but 1, in which they were moderately enlarged. There was generally not even a sulcus between them in front, but in 2 cases it was shallow. In 2 cases enlargement of the anterior portion of the prostate was present. The vesical mucosa was everywhere intact, but the cystoscope showed in 2 cases an elevation of the trigone, which involved only the anterior portion in Case II. In Case III the trigone was considerably elevated and irregular, extending out on the left side as far as the ureter. In 8 cases the trigone was negative.

At operation the lower ends of both ureters were intentionally excised for a short distance in Case II, the operator thinking that the disease had reached this point. This was a mistake, as it was afterward found that the induration was inflammatory in character. In

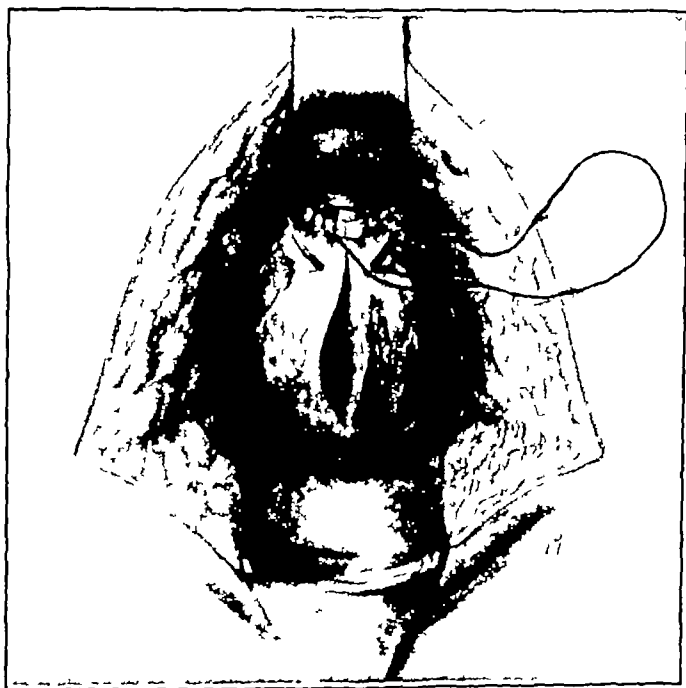


FIG. 500 —Anastomosis completed, remainder of bladder opening being closed with continuous chromicized catgut.

Case V the lower end of the left ureter was involved and had to be excised. This patient died of shock, and autopsy showed that while the seminal vesicles were free the disease had travelled into the peritoneal cavity. The cystoscopic evidence of elevation of the whole trigone should evidently militate against the radical operation, as shown by this case. In Case III the lower end of the left ureter was unintentionally divided with scissors in making the division along the left lateral wall of the bladder. Anastomosis was made high up and no inconvenience resulted (the patient living three years). In 9 cases the operation was carried out with apparent success and without shock, but a study of the specimen removed showed carcinoma near the upper limit in 2 cases (Cases I and III). In Case V (patient dying

of shock) autopsy showed extensive carcinoma of the peritoneum and retroperitoneal glands although the bladder and seminal vesicles were free from invasion. In Case I the patient died nine months after the operation as a result of traumatism and infection caused by an attempt to remove a stone adherent to a silk suture. Autopsy showed a very small area of recurrence 1 cm. in diameter back of the bladder. In



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to reveal any evidence of carcinoma, and it seems probable that the disease had been completely eradicated. Two patients have apparently been cured. One died six and a half years after the operation and the other is well five and one-half years after the operation. In both of these cases the operative specimens showed that the disease had not reached the upper line of excision. Three patients operated upon two years ago are alive and apparently well.

A further study of the ultimate results in these radical cases was carried out on July 1, 1922, and is as follows:

Up to date there has been 19 cases. The ages at time of operation were:

2 cases between fifty and sixty years of age

13 cases between sixty and seventy years of age

4 cases between seventy and eighty years of age

The ultimate results are known in 18 cases and are as follows:

CASE I — Lived nine months after operation and died of sepsis following urethral instrumentation. Autopsy showed recurrence.

CASE II — Died six weeks after operation of pyelonephritis. At autopsy, no carcinoma was present.

CASE III — Lived three years and two months after operation and died of recurrence.

CASE IV — Lived six and a half years after operation and died without recurrence. Careful autopsy was performed.

CASE V — Died from shock. Autopsy showed peritoneal and deep glandular metastasis.

CASE VI — Alive and well thirteen years after operation.

CASE VII — Lived eight and a half years after operation. Patient's doctor reported operative result excellent. No metastases.

CASE VIII — Patient died in hospital three weeks after operation from sepsis.

CASE IX — Apparently well on examination six years after operation. Died eight and three-quarter years after operation of cancer of liver.

CASE X — Alive and well eight years after operation.

CASE XI — Died two years after operation of "acute heart failure." Excellent operative result. No recurrence.

CASE XII — No reply to letters.

CASE XIII — Alive and well five years after operation.

CASE XIV — Alive and well three years after operation.

CASE XV — Alive and well. No incontinence two and one-third years after operation. Examination negative for recurrence.

CASE XVI — Died nine months after operation, local recurrence and metastases.

CASE XVII — Lived one year and nine months after operation. Examination at the end of eight months showed no evidence of recurrence. Cause of death unknown.

CASE XVIII — Recent case. Alive and well six months after operation.

CASE XIX — Recent case. Alive and well seven months after operation.

Summary—Total number of cases 19 Died from operation, 1 Died from postoperative infections, 3 (renal, 2 purulent 1) No recurrences at autopsies. Died from recurrence or metastases 3 Died cause and time unknown 1 Not heard from 1 (Case VII)

Remote deaths no evidence of recurrence or metastasis 2 patients Case XVII lived one year and nine months after operation Case VII lived eight and a half years after operation

Alive and well duration of each as follows Thirteen years eight years, five years, three years two years eight months six months. Total 19 cases

No recurrence after operation at autopsy or on clinical report 1; doubtful 1 Percentage of probable cures of carcinoma by operation to date 80 per cent Well three years or more 70 per cent (not including the 3 cases which died of infections in which autopsy was negative for carcinoma)

These results show conclusively the value of the radical operation

In the first cases there was incontinence when the patient was on his feet but when in bed and in a sitting posture there was fair control In more recent operations control has been much better in Case IX hardly any incontinence and in Cases X to XVII no incontinence at all the patient voiding naturally with normal force only three or four times by day and none at night. This has been accomplished by using great care to elevate the anterior layer of pelvic fascia which encloses the lateral and anterior aspects of the prostate with the nerves and blood vessels of that region This not only obviates hemorrhage but preserves the vascular and nervous supply of the triangular ligament and sphincter and thus prevents incontinence and removes the one object to the operation

As a result of the experience gained in these 19 cases it may be said that the operation should not be attempted when the infiltration extends more than a short distance beneath the trigone as determined by the cystoscopic examination with the finger in the rectum and the cystoscope in the urethra nor where the upper portions of both seminal vesicles are involved nor where an extensive intervesicular mass or indurated lymphatics or glands or involvement of the membranous urethra or muscle of the rectum shows that the disease is manifestly too far progressed that the corners of the trigone containing the ureteral papillae should be left intact with sufficient tissue below them to ensure proper suture and to leave their opening free from constriction 1 or 2 cm above the wound that when the operation is attempted early it can be performed without much danger or great difficulty and with excellent chance of cure.

The foregoing statistics were given in the first edition of this work After much effort we have succeeded in 1936 in obtaining reports of the ultimate results four years or more after the patient left the hospital in all but one case.

1 Living and well over five years at last report 7 cases Twenty two years 1 case twelve years 1 eleven years 1 ten years 1 nine years 1 eight years 1 six and a half years, 1

2 Died five years or more after leaving the hospital, and reported by their physicians to have had no recurrence or metastases, 9 cases Interval fifteen years, 1 case, nine years, 1, eight and a half years, 1, seven years, 2, six and a half years, 2, six years, 1, five years, 1

One patient died less than five years after operation of another disease A very careful autopsy showed no recurrence or metastases

We have, therefore, 17 cases (53 per cent) apparently cured There are 4 patients who have died, but their physicians reported they were clinically well, viz, 1 died two years after operation from heart failure, 1 died three and a half years after operation from hypertension and apoplexy, 1 died four years after operation with no recurrence, cause of death not stated, 1 died three and a half years after operation from pneumonia There are 2 patients operated upon more than four years ago, who report they are alive and well, with no recurrence or metastases

Careful clinicians are reluctant to claim positive cures from operations for carcinoma It seems evident that a good deal more than 50 per cent of our cases have shown no recurrence or metastases The perineum is the only route by which the diagnosis of carcinoma of the prostate may be confirmed by inspection, incision, biopsy, and if the disease is not too extensive, a radical cure obtained probably in over 50 per cent of the favorable cases

Radical Cures by Partial Prostatectomies—Two cases, in which small nodules of cancer were completely removed in the course of perineal prostatectomy for supposed benign hypertrophy, have been cured, and therefore deserve mention They are reported elsewhere

The literature on the radical cure of cancer of the prostate has become fairly voluminous since my first paper in 1906 Interest has been greatly increased by the fact that this subject was assigned for report and discussion at the International Medical Congress in London, 1913, and at the International Association of Urology in Berlin in 1914 At London reports of successful results with the operation were made by Joly, Wildbolz, Légeu, and others, and at Berlin excellent clinical compilations from the literature were made by Verhoogen, Schapiro, and Wildbolz The consensus of opinion was that for radical cure radical excision was necessary, and that good results could be expected if the operations were performed early

II *Subtotal radical excision of carcinoma*, with conservation of sphincters, and most of the urethra and capsule This operation has been carried out in 4 cases The first case showed a well-circumscribed area of carcinoma in the right half of the prostate The right lateral lobe lay in front of this and was an adenomatous hypertrophy, the left and median lobes of the prostate were also benign hypertrophies The area was so well circumscribed that I did not perform the typical radical operation but contented myself with removing the right half of the prostate with its capsule, the right lateral wall and floor of the urethra, the suburethral tissues with ejaculatory ducts and lower portion of the right seminal vesicle and vas deferens, all in one piece The

left lateral and median lobes were then excised as usual preserving the roof left lateral wall of the urethra and vesical sphincter.

The result was splendid. Perineal fistula closed on the ninth day patient discharged on the fourteenth day. Report by letter five years later. "Entirely well urination normal."

Two other patients have been operated upon by a similar technique also with excellent results now four years in 1 case and the method can be recommended in cases in which a small nodule of carcinoma well circumscribed and surrounded by healthy tissue is present. Great care must be exercised however in choosing cases and the radical operation is generally the safer to employ.

III Typical Conservative (Partial) Prostatectomy—Seventy-one cases. This operation was done with no idea of radical cure but merely to remove the obstruction to urination. In 2 cases however a small nodule of carcinoma was completely excised in the removal of the lateral lobes.

In one case the carcinoma lay adjacent but not within an adenomatous lobe but was radically removed as shown by the fact that the patient is alive now eleven years after operation.

The other case was one of obstructive prostatitis the microscope showing a small but definite nodule of cancer in the tissues removed from one lobe. The patient is alive and well now seven years after operation.

In 71 cases conservative perineal prostatectomy was carried out to remove the obstruction and thus furnish relief from very difficult and painful urination or a painful catheter life.

Discovery of the fact that a manifestly incomplete operation of this character could give lasting functional results came accidentally but has now been tried sufficiently to make it an operation of election in many cases.

It has indeed been surprising to find patients with extensive carcinoma of the prostate and seminal vesicles permanently relieved of obstruction to urination by a simple shelling out of the carcinomatous tissue from the lateral and median portions of the prostate but such is most often the case.

The operation is as follows. A description of the principal steps in the operation of conservative perineal prostatectomy seems desirable here as many of the steps are the same as for the radical operation for cancer of the prostate.

Position of the Patient—The exaggerated dorsal position of the patient is the most satisfactory and the perineal board devised by Halsted is admirably suited for this purpose. The perineum should be so elevated that it is almost parallel with the floor thus allowing excellent retraction of the rectum and splendid exposure of the posterior surface of the prostate. After placing the patient upon the table before elevating the thighs a No. 24 F. sound should be inserted into the posterior urethra to be used subsequently as a guide for urethrotomy. If the operator waits until the patient is placed in the urethrotomy

position he will frequently find it difficult to introduce the sound through the triangular ligament

Cutaneous Incision — The inverted U cutaneous incision unquestionably gives a far better exposure than a median incision. The apex



FIG 502 —Opening up space on each side of central tendon for conservative or radical operation

should be just over the posterior part of the bulb, about 2 inches in front of the anus, and the lateral branches directed outward and backward parallel to the ischiopubic ramus, each about 2 inches in length. The incisions are carried through the skin, fat, and superficial fascia, and then by blunt dissection with the handle of the

scalpel and the index finger of the left hand the space to each side of the central tendon is opened up. In this way it is very simple to open up by blunt dissection very quickly a space on each side reaching as far as the triangular ligament. In so doing the levator ani is pushed backward and outward on each side and the transversus perinei muscles are pushed forward (Fig 502)

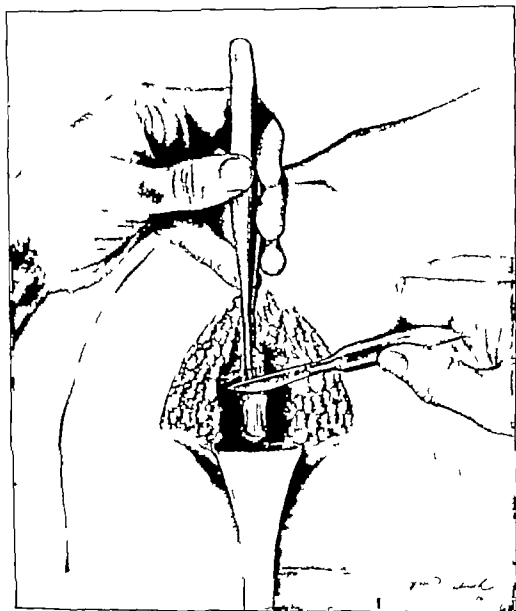


FIG 503 —Bifid retractor inserted. Division of central tendon and recto-urethralis muscle beneath it.

Exposure of the Membranous Urethra —The bifid retractor is inserted. Traction upon this instrument gives an excellent exposure of the narrow band of central muscle and tendon and greatly facilitates the division close to the bulb without injuring this hemorrhagic structure

as shown in Fig 503. After the central tendon has been completely divided and the posterior surface of the bulb freed it is well to insert a grooved retractor by which the bulb and triangular ligament and external sphincter are drawn upward and a better view obtained of the recto-urethralis muscle, which lies between the two branches of the levator ani and covers the membranous urethra, toward which it draws the anterior wall of the rectum. In dividing the recto-urethralis muscle, care should be taken not to injure the rectum, which is often drawn forward so that it lies almost in front of the membranous urethra. It nearly always covers the apex of the prostate. As soon as the recto-urethralis has been thoroughly divided it is easy, by blunt dissection, to push the rectum backward and thus obtain a good view of the mem-

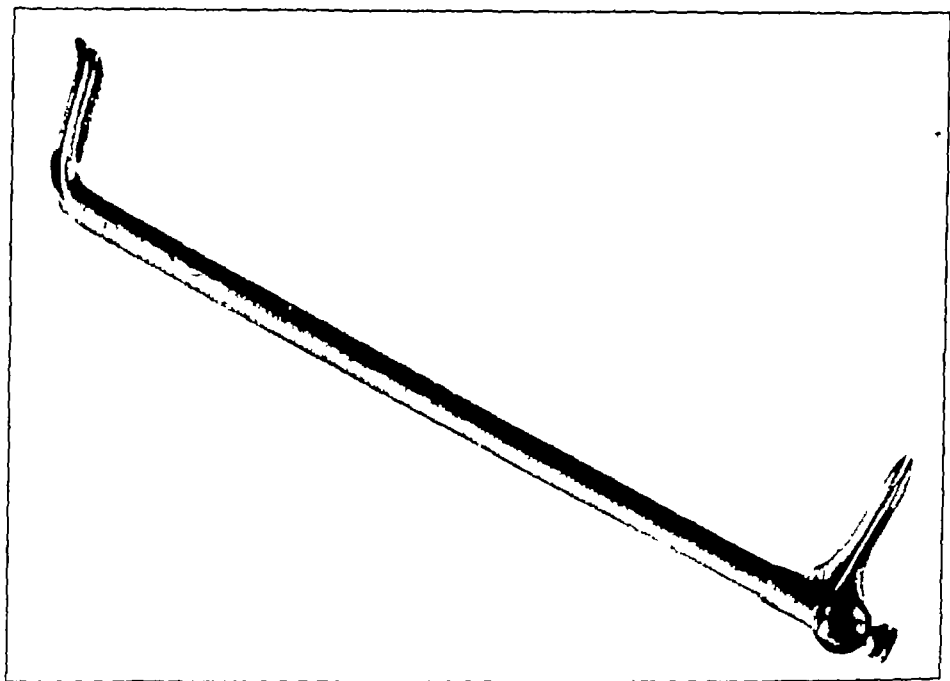


FIG 501 — Young's prostatic tractor (closed)

branous urethra, the bulb being drawn forward along with the muscular structures of the triangular ligament. The membranous urethra is then opened upon the sound and the edges picked up with artery clamps, being sure to secure the mucous membrane. A straight sound is then inserted into the bladder through the urethral wound (an assistant having withdrawn the sound from the anterior urethra), to open up the way for the prostatic tractor (Figs 504 and 505). In these cancerous cases it may be necessary to stretch the contracted posterior urethra considerably with a glove-stretcher before it is possible to insert the tractor into the bladder through the perineal urethrotomy wound. Owing to the pronounced curve of this instrument (Fig 504) it is sometimes difficult to insert. Sometimes it is well to begin its introduction with the beak turned backward and then to rotate the instrument 180 degrees before

carrying it into the bladder. After the instrument has penetrated into the prostatic urethra it is generally advisable to remove the anterior bulb retractor and thus allow the shaft of the tractor to be carried farther forward. As a rule, little difficulty is experienced in inserting the tractor if one has been careful to secure the edges of the mucosa

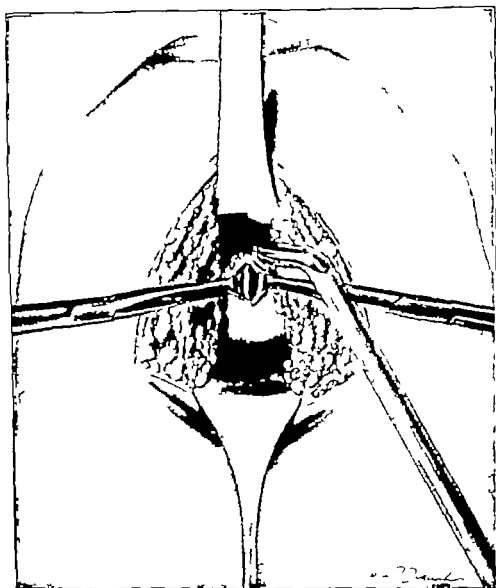


FIG. 505.—Membranous urethra opened on sound, edge caught with clips, tractor about to be introduced.

of the membranous urethra. After reaching the bladder the blades of the tractor are opened out by means of the external handles (Fig. 506) and after being fixed in this position by means of a set-screw, traction is made upon the prostate and the farther separation of the rectum from the posterior surface of the prostate made. After dividing the recto-urethralis muscle and exposing the apex of the prostate one generally

finds it necessary to use the knife to divide a layer of fibrous tissue which lies behind the posterior surface of the prostate. After this (the posterior layer of Denonvillier's fascia) has been divided the rectum can be more easily pushed backward, and one enters, generally with ease, into the space between the two layers of Denonvillier's fascia and the smooth, glistening surface of the prostate is exposed (Fig 507). When this layer is properly exposed no difficulty is generally experienced in rapidly freeing the entire posterior surface of the prostate and seminal vesicles, a good view of which is obtained at once by the insertion of a broad angular retractor posteriorly.

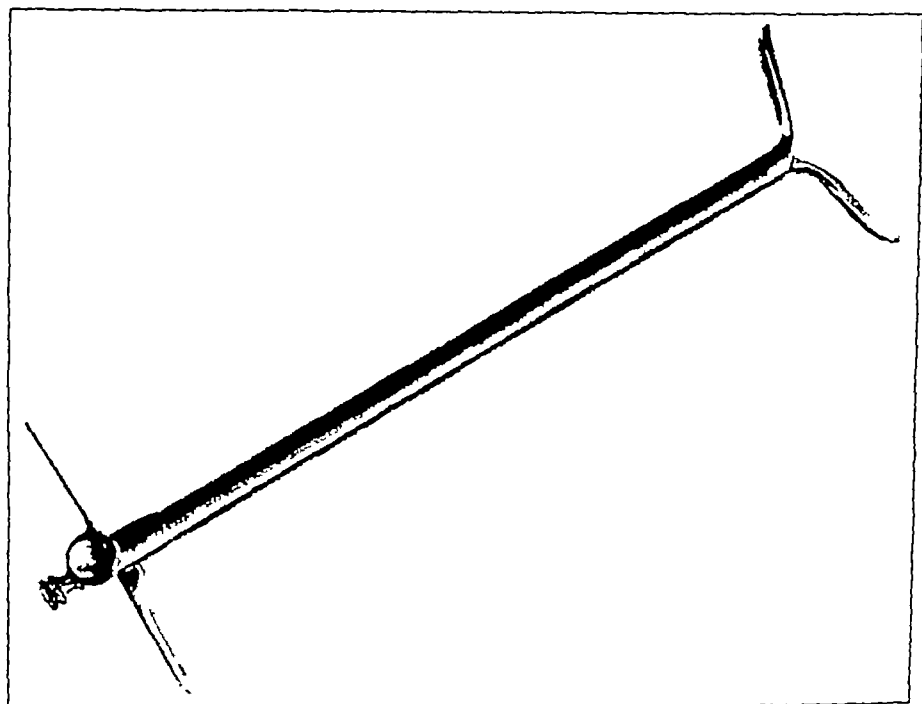


FIG 506 —Prostatic tractor opened, as in operation

Incision of Capsule —Lateral retractors are so placed that with the posterior retractor drawing the rectum backward, and the prostatic tractor drawing the gland outward a splendid exposure of the posterior surface of the prostate is obtained. An incision is then made through the capsule on each side of the median line for almost the entire length of the posterior surface and about 1.5 cm deep. These incisions are about 1.8 cm apart behind and 1.5 cm apart in front, as shown in Fig 508. The bridge of tissue which lies between them contains the ejaculatory ducts and the floor of the urethra.

The lateral lobes are then each completely removed, much of this being done by the blunt dissector. When the deep portion is reached—that is, at the base of the seminal vesicle and the bladder—it is often necessary to use a sharp periosteal elevator or a curette in order to completely remove all of the carcinomatous prostatic tissue in that region. The entire lateral mass of prostatic tissue usually comes away in one

piece but in those cases in which the cancer is confined to the posterior subcapsular layer in front of which is a hypertrophied adenomatous lobe the latter is usually separately enucleated. After the two lateral

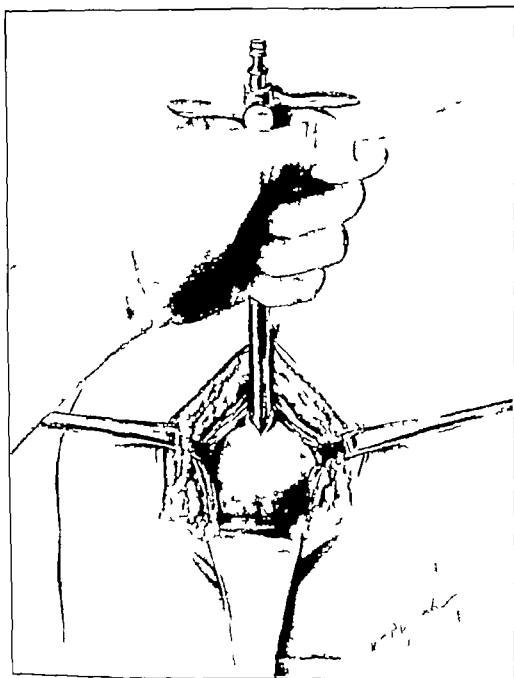


FIG. 507.—Prostate drawn down by tractor posterior surface freed.

cavities are emptied the median portion of the prostate is next attacked. This is indicated in Fig. 509 in which the median portion is shown diagrammatically caught with a sharp hook. It should be our object here to excise this median suburethral portion without injury to the

ejaculatory ducts which lie behind it (in order thus to avoid epididymitis), and with as little injury to the urethra in front of it as possible. Remaining tissue can be removed with scissors, curette, or rongeur. If a rounded middle lobe is presented it may be drawn down and removed through a lateral cavity (Fig. 510). It is then advisable to remove the tractor and dilate thoroughly the vesical orifice with large forceps. The finger is then carefully inserted through the urethra and an exam-

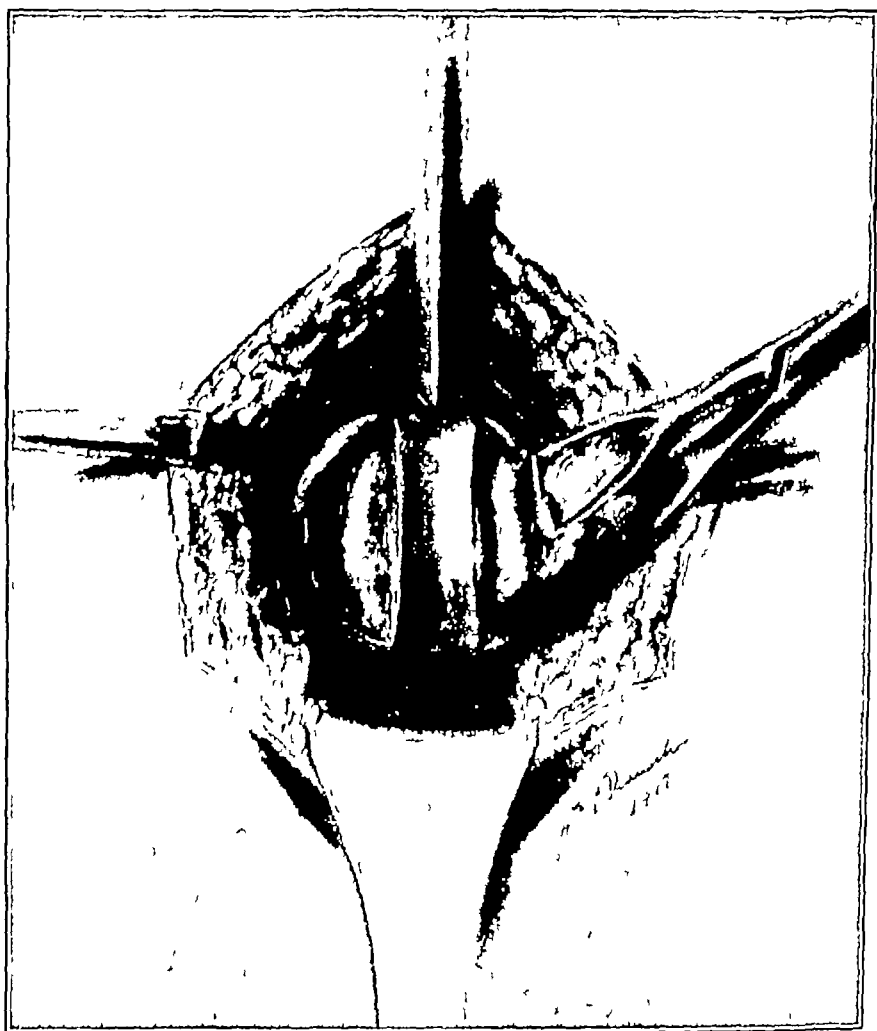


FIG. 508 — Incision of capsule and enucleation of lateral lobes

ination of the vesical neck made. As a rule the sphincter will be found tight, or often sclerotic, and thorough dilatation should be made. If there remains any prostatic tissue in the median portion or elsewhere around the orifice this can easily be enucleated or excised, using the finger as a tractor. Young's "punch" may be used very advantageously here to cut away the contracture of the vesical orifice. The instrument is passed through the urethrotomy in the membranous urethra, opened out engaging the tissues. In some cases the carcinomatous

infiltration continuous with the median bar and extending beneath the trigone is felt and it may be advisable to remove this more or less completely (which can usually be done with ease with a curette working upon the finger in the bladder against the trigone as a guide) Care should be taken not to tear a hole in the urethra or bladder, but it is a remarkable fact that although the urethra may have been torn laterally or posteriorly during some of my operations and in a few cases a small portion excised the healing in these cases has

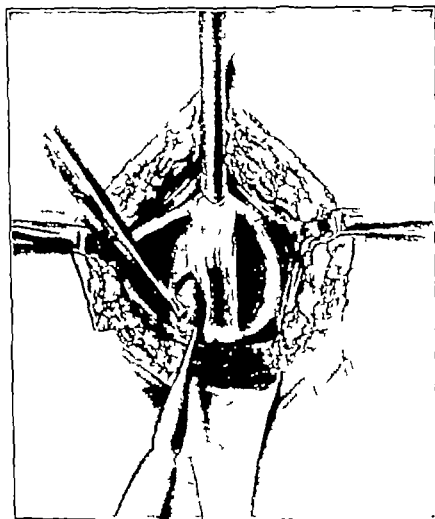


FIG. 500.—Excision of infiltrated median bar

been entirely satisfactory and there has been no evidence of intra urethral ulceration or tumor outgrowth through the rent. If a globular median lobe is present this is usually easily enucleable as in cases of benign hypertrophy. In those cases in which benign adenomatous enlargement of the prostate is present at the same time as carcinoma (and this amounts to about 50 per cent of the cases of carcinoma) the lateral lobes instead of being resected can be enucleated easily. In such cases it is often possible to draw the middle lobe out through the

right lateral cavity along with the right lateral lobe. The operation is distinctly simpler than in those cases in which the condition is entirely carcinoma. The results obtained are equally good. The rest of the operation is similar to that for benign cases. A large drainage tube through the urethra into the bladder, irrigation begun at once, the lateral cavities packed each with strips of iodoform gauze (Fig 511), the levator ani muscles drawn together in front of the rectum with a

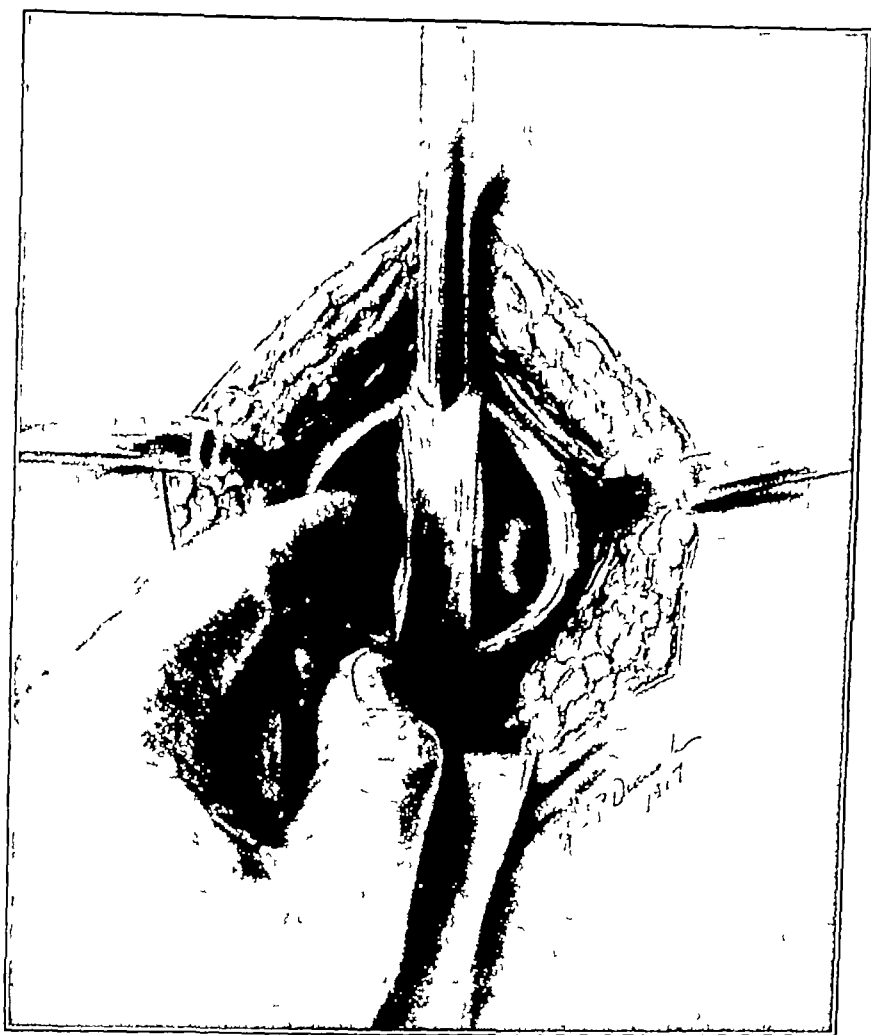


FIG 510 — Removal of rounded median lobe through the left lateral cavity

single suture of catgut, and the skin approximated on one side by the interrupted sutures of catgut. If the patient is very weak an infusion is often begun at the beginning of the operation, but usually we wait until the return to the ward. From 500 to 800 cc are generally given beneath the breasts. Irrigation, begun on the operating table, is given intermittently in the ward. The patient is given water to drink as soon as possible and an effort is made to make him take as much as he can. The gauze is generally removed on the morning after the operation,

and the tubes during the afternoon when all bleeding following the removal of the gauze has ceased. On the following day the patient is usually put in a wheel-chair and taken outdoors and as a rule the convalescence is as rapid as we see after perineal prostatectomy for benign hypertrophy. In fact owing to the small size of the cavity the closure of the fistula and restoration of normal urination are usually somewhat quicker as shown by reference to the detailed report elsewhere of cases treated by perineal prostatectomy.

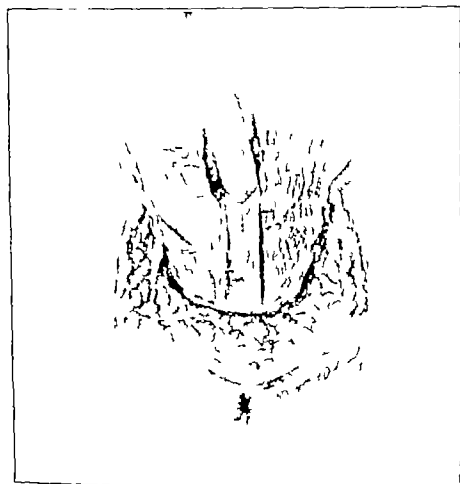


FIG. 511.—Lateral cavities in prostate packed with gauze. Tube drain of bladder through membranous urethra.

Results of conservative perineal prostatectomy in 71 consecutive cases of cancer of the prostate. There were 4 deaths none immediately following the operation the earliest being twenty three days after operation for uremia and the others twenty-six thirty-six and forty-nine days after operation. All of these were desperate cases suffering greatly operation being performed in hope of relief and having little to do with the fatal ending. The mortality of 5.6 per cent is therefore not just to the operation. The results obtained have been analyzed and tabulated as follows

A Good Result as Long as Patient Lived, 24 Cases —In these cases the operation was entirely successful in removing the obstruction permanently. The duration of life was over four years, 1 case, over three years, 3 cases, over two years, 5 cases, over one year, 4 cases, six to twelve months, 5 cases, under six months, 6 cases.

Many of these cases were remarkable not only in being completely free from urinary obstruction, but also in being otherwise comfortable almost up to the end.

Twelve of the 24 cases are reported to have had no pain up to death. In 7 severe pain, generally in back or thighs, was present. It was present before operation in most of these cases, but there were others not in this group in which severe pain developed later. I think I can safely say, however, that it is not hastened by operation and is often relieved thereby. Fenwick pointed out years ago that in cancer of the prostate, pain would often disappear when the disease broke through the capsule—apparently thus relieving tension.

B Patients Still Alive and Entirely Relieved of Obstruction to Urination, 14 Cases —Twelve of these cases are free from pain. In 3 a pin-point fistula exists. No hematuria is reported, and none has required catheterization, micturition being fairly normal. The duration since operation is three years, 1 case, over two years, 2, over one year, 5, between six and twelve months, 2, indefinite, 2. If Group B be added to Group A we have 38 in 71 cases with excellent operative result, or 53.5 per cent. To this may be added 11 cases in which, although the operative result, removal of obstruction and restoration of free urination has been accomplished, still accompanying conditions, present before operation, have been so severe as to negate the results, *e. g.*, 7 patients were terrible sufferers from pain (generally in back and legs) before operation, and this still continued in such severity as to overshadow everything else. In 2 there was very little residual urine before operation, and the size of the bladder was small. Urination has since been free but frequent. In only 1 case were there hemorrhages. These were all bad cases, 3 lived less than one year, 7 between one and three years, 1 is still alive. They represent a class of patients whose sufferings are so intense from pain, and difficulty and frequency of urination are so great, that something is demanded.

The operation, however, relieved the obstruction permanently, and these should, therefore, be added to the previous groups, thus giving as results in removing obstruction and giving free urination 49 in 71 cases, or 69 per cent successful.

C Partial Recurrence of Obstruction —There were 4 cases (5.6 per cent) in which the obstruction relieved for a time partially returned within six months in 3 cases and after eighteen months in 1 case. The latter patient lived over four years, the others twenty-two, ten, and four months respectively. None of these 4 patients returned to the catheter life, and all were undoubtedly improved by operation.

D Complete Recurrence of Obstruction —This class comprises 11 cases in which recurrence of obstruction was sufficient to require catheteriza-

tion in 3 cases (7 per cent) a Bottini operation in 1 case suprapubic drainage in 4 cases (36 per cent) suprapubic prostatectomy in 1 case.

In 4 of these cases the obstruction returned within six months after operation, in 2 within a year in 2 over two years later in 1 over three years later. These cases may therefore be set down as failures 10.6 per cent although a definite period of freedom from obstruction was afforded. Three patients lived one year 3 over two years. In 8 of these 11 recurrent obstruction cases hypertrophy was present (74 per cent) and 1 patient was subsequently relieved of the obstruction by suprapubic enucleation of two large adenomatous lateral lobes normal urination being restored. In this case the cancer lay entirely in the posterior part of the prostate and seminal vesicles. Freyer has reported similar cases in which the demarcation was so sharp that suprapubic enucleation could easily be carried out successfully.

The patients in this group were happily free from pain in all but 2 cases.

Careful review of the operative notes fails to reveal any reason for the recurrence of obstruction in these 11 cases—apparently the removal was just as completely successful as in the other cases which remained free from obstruction. Perhaps it is surprising that in more cases this frankly partial operation is not temporary in its results.

Complete Radical Cures—2 Cases—These 2 cases were accidental cures. The cancer in each case was only a small nodule not recognized until after operation but removed with a sufficiently wide margin of healthy tissue so that a complete cure has been obtained. Both patients are alive and well now seven and a half years in 1 case and eleven years in the other.

These cases may be used as an argument for early perineal prostatectomy.

General Remarks—The foregoing study of 71 patients with cancer of the prostate in which 69 per cent were permanently relieved of obstruction to urination demonstrates fully I believe the great value of perineal prostatectomy where care is taken to remove the cancerous lateral and median lobes and any adenomatous hypertrophy which may coexist as it has been shown to do in 61 per cent of the cases. Special care should be taken to see that the vesical orifice which is often contracted is well dilated and that no small spheroids of hypertrophied tissue remain as these have probably caused the recurrence of obstruction in several of my cases. To recapitulate. We have in 71 cases treated by conservative perineal prostatectomy complete cures, 3 per cent permanently successful removal of obstruction 69 per cent partial recurrence of obstruction 36 per cent recurrence of complete obstruction 10.6 per cent deaths in hospital 5.6 per cent—the earliest twenty-three days—and no deaths strictly attributable to operation. Of the 250 cases of cancer of the prostate seen in the Urological Clinic up to the year 1915 in 100 of these perineal prostatectomy was carried out. In 70 per cent of these there was no return of obstruction up to the time of the patient's death many of these patients living

a number of years. Of these 100 cases, there was an operative mortality of 3 per cent. In 70 cases it has been possible to secure information concerning the duration of life. Sixteen of these lived less than six months, 15 between six months and a year, 12 between one and two years, 10 from two to three years, and 17 three years or more. Of these 17 cases, 9 lived between three and four years. Of the remaining 8 cases, 2 lived about four and a half years, 2 six years, 2 nine years, and 2 fourteen years. The average time of closure following operation differs not at all from the time of closure in the benign hypertrophy cases. In 7 cases, a fistula persisted up to the time of death. In none of these 100 cases, in which prostatectomy was carried out, was anything more than relief of obstruction contemplated, and there was no attempt or thought of eradicating the disease. The low mortality and the relief of distressing obstructive symptoms secured by this operation, relief in the majority of cases extending up to the time of death, is a sufficient justification for this operative procedure.

IV *Suprapubic Prostatectomy, 2 Cases* —The prostate was enucleated in 2 cases, in both of which the malignant nature of the disease was not recognized. One of these was operated upon in 1898 by another surgeon and resulted in death thirty hours after the operation. Autopsy showed numerous pelvic metastases. In the second case I failed to recognize the malignant nature of the disease and performed a suprapubic prostatectomy after removing a very large vesical calculus. It was impossible to separate the prostatic lobes from the urethra, and the entire prostate was shelled out in one mass along with the urethra. The patient returned five years later complaining of a tumor of the kidney. He reported that there was no difficulty or frequency of urination and that the operation had cured him completely. Rectal examination, however, showed a large indurated mass in the region of the prostate, and seminal vesicles, and study of the microscopic sections of the prostate removed at operation showed carcinoma, thus explaining the nature of the supposed kidney tumor. The patient died a few months later. The prostatic enlargement in this case was largely due to adenomatous hypertrophy. This probably accounts for the ease with which it was shelled out suprapublically. In cases in which there is no hypertrophy present, but the prostate is of the small, hard variety, as seen in many of our cases, it would seem almost impossible even to start the enucleation through the bladder and that for such cases a suprapubic prostatectomy is out of the question. Freyer agrees to this. The fact that the urethra comes away with the prostate in these cases is, I believe, a distinct objection to the suprapubic route even when the presence of intravesical adenomatous lobes make it possible, as the cavity may fill up with a fungating carcinomatous growth.

It seems advisable here to refer to recent papers by Freyer and by Judd.

In the *Lancet* for December 13, 1913, Freyer gave his statistics in regard to cancer. He says he has seen 171 cases of cancer to 1105 of

hypertrophy or 13.4 per cent of all cases were cancer. He does not give the number of these cancer cases which was operated upon nor has he had complete pathological studies made of all the prostatectomy specimens to see how many contain cancer. He details however 10 cases in which suprapubic prostatectomy was successfully carried out the entire prostate with the urethra anterior commisure and "true capsule" being removed in one piece. That this procedure may be radically successful in certain early cases in which the cancer is not too close to the capsule, and still confined within the substance of the prostate, is quite admissible and this is borne out by the fact that in 5 of Freyer's 10 cases the patients have been well now from six to ten years since operation.

Freyer does not recommend the procedure as a radical operation and remarks: "I could give details of other cases in which the results were not so satisfactory, the disease recurring and leading eventually to contraction of the urethra" etc.

One of my cases (mentioned above) operated upon as early as 1901 and published in 1909 demonstrated that it is possible occasionally to get a good functional result for over five years—death finally supervening from cancer—but such are rare and the general consensus of opinion is that cancers of the prostate should not be attacked suprapubically.

In Judd's paper before the Southern Surgical and Gynecological Association 1914 he reports among 578 specimens removed by prostatectomy 93 containing cancer studied microscopically. Seventy-five per cent showed a coexistent hypertrophy and he confirms our discovery that in such cases "the malignant process always started in the posterior lobe and was often distinctly separated from the rest of the gland which was not involved."

He has heard from 82 of the 93 patients but gives no figures as to the number of successful cases simply remarking that "many of the patients living at the present time are entirely free from symptoms." "In the cases of recurrence hematuria was one of the first evidences of the recurrence. Difficulty of urination was an early symptom and became rapidly marked necessitating suprapubic cystotomy in a number of cases. Several lived three years without trouble when there was a return of all symptoms. One patient living nine years had a small carcinomatous nodule removed. "Twenty-four died within the first six months."

In a paper by Judd, Bunpus and Scholl "a clinical and pathological study of 146 operative cases was made. Of 70 patients traced who were operated upon by the suprapubic route 14 per cent lived more than three years after operation. Of 42 patients traced operated upon by the perineal route, 12 per cent lived three years. In a study of 231 untreated patients the subsequent duration of life was found to be almost three years. From this the conclusion is drawn that operation has little to offer. (It must be remembered however that the comfort obtained by operation is generally very great.)

V *Bottini Electrocantery Operation, 8 Cases.*—The Bottini operation was employed to relieve prostatic obstruction in 7 cases. In 4 of these cases the diagnosis of carcinoma was made, and the operation employed simply as a palliative procedure with distinct improvement in all 4 of them.

In 3 cases the malignant nature of the enlargement was not recognized, and the Bottini operation was employed, as I was using it to the exclusion of other methods at that time. The results obtained were very good in all 3 cases. In 1 case the obstruction recurred, and the patient died within a year. In the second case the result was excellent for sixteen months when symptoms of obstruction again appeared, and suprapubic cystotomy for drainage had to be employed three years after the Bottini operation. The last case has been remarkable for the immense benefit conferred by the Bottini operation. For almost six years after the Bottini operation the patient lived free from pain and discomfort, although the prostate and seminal vesicles were markedly involved, and general glandular metastases were present. A review of these 7 cases shows several remarkably good results with the Bottini operation, but, as a whole, perineal prostatectomy is the preferable operation where it is desired to relieve the patient from the necessity of painful and difficult catheterization, and the discomforts of life with a suprapubic drainage apparatus.

VI *Transurethral Resection*—Very early in our transurethral work we removed the carcinomatous obstruction by means of our prostatic excisor or punch. The most satisfactory cases were those in which, on cystoscopic examination, no markedly rounded lobes were present at the vesical orifice, and the condition was in the form of a contracture or bar, which appeared to be amenable to treatment by excision with the punch. The operation varies from three cuts, to remove the posterior bar, to a number of cuts, which included also the lateral margins of the vesical orifice. In these cases sometimes a simple inlying catheter was alone employed to arrest hemorrhage and provide drainage, but in recent years it has been found more satisfactory to insert a cystoscope and apply high-frequency fulguration to the bleeding points. In this way, without destruction of tissue, complete arrest of hemorrhage can usually be obtained quickly. An inlying catheter is provided, and removed within a few days.

More recently, with the introduction of electric resection, this procedure has been employed. In some instances the instrument of Steiner, as modified by Davis, has been employed. In other cases the McCarthy instrument has been used. The amount of tissue removed has varied greatly. In some cases, in which the prostate was considerably enlarged, many bits were resected, in others, only a few. Hemorrhage was arrested by the application of the coagulating current. The operation usually occupies a much longer period of time than the punch operation, and in the cases of great enlargement arrest

of hemorrhage necessitated the destruction of much tissue, which came away afterward in the form of sloughs

The results by these methods, both the punch and electric resection operation have been very satisfactory in many cases at least for a time. In some of these it was not long before serious obstruction recurred and a conservative perineal prostatectomy to remove the obstructing median and lateral lobes had to be carried out. Even after this in one case complete obstruction recurred again and was treated by an inlying catheter. This was well borne by the patient for many many months in fact it is quite remarkable how satisfactory a number of patients have found an inlying catheter when complete retention of urine is present. (See also Section III of Chapter XVIII on Transurethral Resection by Bumpus)

VII *Castration 2 Cases*—Castration was performed for the relief of prostatic obstruction in 2 cases many years ago. In 1 case the operator did not recognize that the disease was carcinomatous and performed castration which was then in vogue in order to produce an atrophy of the enlarged prostate. Suprapubic cystotomy for drainage was provided at the same time. The result was negative, and the patient wore a suprapubic drainage apparatus until his death a year or so later.

In the second case which was operated upon by the writer the diagnosis of carcinoma was evident. There was no frequency or difficulty of urination but the patient complained of severe pain in the rectum, buttocks and limbs. No operation to relieve obstruction was indicated and castration was performed with the hope that some change in the prostate which might bring about relief of the rectal pain might follow. The result however was negative.

VIII *Suprapubic Drainage 13 Cases*—In all these cases the catheter was tried first and the operation performed either because it was impossible to introduce the catheter or its use was so painful or difficult that catheter life could not be endured. In several cases the patient employed the catheter for a long period before finally demanding operative relief. In nearly all of these cases the disease was far advanced and the condition often desperate. One patient died a week after the operation, one lived only a month, another only five months and a third six months. In these 3 cases the patients suffered very greatly and the operation afforded very little relief. In 2 cases it has been impossible to find the patients since their departure from the hospital. In 6 cases the drainage apparatus was employed and in 5 cases all reports state that it worked well, there was no leakage around the tube, the patients were able to empty the bladder at fairly long intervals by opening the stop-cock, and there was very little pain or vesical discomfort.

As noted above, the results obtained by suprapubic drainage were distinctly better when an apparatus was provided by which the bladder would be emptied only at stated intervals rather than being allowed to drain continuously.

V *Bottini Electrocautery Operation, 8 Cases*—The Bottini operation was employed to relieve prostatic obstruction in 7 cases. In 4 of these cases the diagnosis of carcinoma was made, and the operation employed simply as a palliative procedure with distinct improvement in all 4 of them.

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was avoided. The catheter was generally removed once a week, and was not reintroduced for several hours the anterior urethra being irrigated as the catheter was withdrawn. Although a certain amount of urethritis was always present it was rare that the patient complained. These patients undoubtedly found the inlying penile catheter distinctly less objectionable than some patients who wore a suprapubic drainage apparatus constantly.

VI Cases in which Neither Operation nor Catheter Life was Advised — Twenty nine cases of this type have been studied. These cases present an unusual and interesting group because of the lack of the usual severe obstruction to urination. In 19 cases a catheter had never been used, in 4 cases it had been only occasionally employed. In 1 case acute retention of urine was present on admission and in 4 cases the catheter was employed daily. In 8 cases the difficulty of urination was considerable in 2 cases slight, the increased frequency was considerable in 11 cases moderate in 4 and slight in 7 cases. Pain was the most prominent symptom in most cases and involved various regions from the chest to the feet. The duration of symptoms of the disease was less than one year in 7 cases, two to three years in 14 cases and over three years in 7 cases.

The prostate and seminal vesicles were considerably enlarged in 30 per cent of the cases, so the lack of urinary obstruction was not due to the absence of prostatic enlargement. Among the 21 patients from whom replies have been obtained in only 6 did catheterization become necessary and in 3 of these subsequent operations were necessary (two suprapubic drainage and one perineal prostatectomy with relief from catheter life). Among the 21 patients that have been heard from 7 are still alive, 3 of them six months, 3 between six and eleven months and 1 one year after being seen by us. In these 7 cases the patients have lived five, four, three and two years, nine, nine and seven months since the beginning of symptoms. Fourteen patients have died since our examination, having lived less than six months, 4 cases, between six and eleven months, 2 cases, one year, 1 case, two years, 3 cases, and three years, 2 cases. The total length of time these patients lived after beginning of symptoms was under six months, 1, under one year, 1, over one year, 1, two years, 4, three years, 3, four years, 1, five years, 1, eight years, 1, ten years, 1.

This class of cases, therefore, is remarkable for the extent of the involvement and the freedom from marked urinary obstruction for long periods. They represent a class in which early diagnosis is difficult unless rectal examination be made before the beginning of obstructive symptoms and for merely slight pain and discomfort in various regions from the chest down (which are shown to be reflexly involved by carcinoma of the prostate). The presence of an indurated prostate in any such case should lead to careful investigation and probably exploratory operation. These cases show the great importance of rectal examinations as a routine in physical examinations.

IX *Perineal Drainage*—Perineal urethrotomy for drainage of the bladder is frequently preferable to suprapubic cystostomy. The operation can be done under local anesthesia, with no shock, no extravasation, practically no rise in temperature or danger of sepsis. Excellent downhill drainage is thus afforded, and it is a far simpler procedure than drainage of the bladder through suprapubic incision. As a temporary procedure it has much to recommend it. For long continued drainage difficulty is experienced in keeping the urethral catheter in place unless a mushroom catheter is employed. We are firmly convinced that perineal prostatectomy is preferable to continuous drainage, either perineal or suprapubic.

X *Cases Treated by Catheterization*.—In a series of 39 cases in which the patient was advised to lead a catheter life, no operation was attempted. In nearly all these cases the disease was too far advanced for a radical operation, but in many of the cases conservative perineal prostatectomy might have been performed with considerable relief. In order to compare the results obtained by the use of the catheter with those of prostatectomy we have attempted to get an accurate idea of the subsequent course of the cases.

It has been impossible to get an accurate reply in all cases as to the progress of catheter life. In 2 cases subsequent operations were required. Suprapubic cystostomy 1, perineal prostatectomy 1. In 10 cases the catheter life was said to be painful, difficult, or very obnoxious and often the catheter had to be used very frequently. In only 8 cases was the catheter life said to have been satisfactory and in 2 of these the patient said it was quite disagreeable. In other cases no reply could be obtained. Final notes have been received in regard to 28 patients. Five are still alive two years, ten months, six months, five months, and five months since admission, and in these cases the disease has been present five years, two years, two years, six years, and four years.

Twenty-three patients are dead, the length of time they lived after being seen by us being a month or less, 6 cases, under six months 3 cases, under a year 6 cases, over a year 6 cases, two years 1 case, five years 1 case.

As seen in this tabulation of 23 cases only 3 patients have lived two years or more since their first visit, so that it would seem that the duration of life after perineal prostatectomy was, as a rule, longer than with a catheter life.

In 2 recent cases, in which both the punch operation and perineal prostatectomy were followed by recurrence of obstruction, continuous treatment by an indwelling catheter has been used with remarkably satisfactory results. In both instances the patient tolerated the catheter quite well, and greatly preferred to have it remain in the urethra than be subjected to interval catheterization. Great care was taken in introducing the catheter, which was of moderate size. The bladder was kept clean by an injection of 0.5 per cent mercurochrome three times daily, sometimes preceded by an irrigation of the bladder with salt solution or boric acid, 2 per cent. In this way stone formation

first edition of this book. Recently our cases have been studied more carefully as to methods and ultimate results.

The first instruments employed were provided with a straight cystoscope the same cystoscope which I have used for several years in the construction of my cystoscopic rongeur. With this cystoscope as a basis the instrument shown in Fig 512 was made and it at once became possible to introduce radium not only into the urethra and rectum but into the bladder where under cystoscopic direction it could be applied to the region desired. It became evident at once that some means of firmly fixing and holding the instrument containing the radium was necessary in order to keep the application against the desired area for the entire period of treatment. Casting

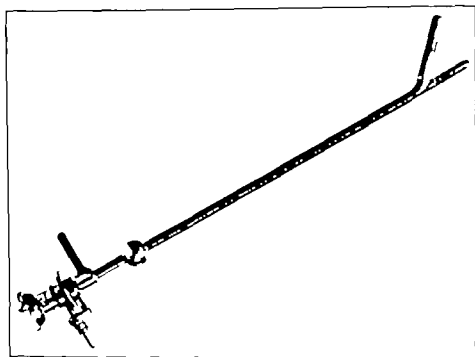


FIG 512 —Young's cystoscopic radium instrument No. 1

about for an instrument, I made use of the cystoscopic clamp or artificial hand which I had employed for several years, to hold a photographic cystoscope in place during exposure of the plates (Fig 513). A ball of appropriate size was then placed around the shaft of the radium applicator which when firmly grasped by the cystoscopic clamp held the radium instrument in its grasp upon the desired spot. The completed instrument is shown in Fig 512. This then was the basis for a series of instruments which have since been constructed the object of which has been to place radium upon a certain spot under the direction of either the cystoscope in the bladder or a finger in the rectum and to hold it there during the entire treatment séance.

It soon became evident that it was not necessary to use the cystoscope for applications of radium in the urethra or at the vesical orifice

THE USE OF RADIUM IN CANCER OF THE PROSTATE

Pasteau and Degrais have contributed several important articles on the use of radium in cancer of the prostate. They made use of from 20 to 50 mg. of radium, screened by a thin capsule of silver and by the gum coudé catheter, in which it was placed by means of a stylet. A No. 17 catheter was used, being large enough to let urine escape around the capsule containing radium, thus allowing the use of radium in the prostatic urethra for several hours.

Their first patient with inoperable cancer of the prostate and adjacent portion of the bladder (hard, nodular, fixed prostate, irregular cancer of middle lobe) had 29 séances of radium treatment (20 to 50 mg. at a time and usually for two hours at a time). He had three treatments in October, 1909, 13 in the next eight months, 7 in the year 1911, and 4 in 1912. As early as February, 1910, the tumor had apparently disappeared, and numerous examinations since (the last being July, 1913) failed to show a return—the prostate being soft, small, mobile, and the bladder negative. On last report the cure had been maintained almost four years. Another case was that of a man seen in 1909 with a hard, nodular, fixed prostate, the cancer extending into the region of one seminal vesicle. Series of radium applications were made in July and August, 1909, with a tube of 50 mg. remaining in place for two hours, the applications being repeated in September and October. In February, 1910, marked improvement was found, and under the influence of renewed application of the rays by the end of 1910 one-half of the prostate was much softer. Series of treatments—three or four two-hour exposures during the course of a month constituted a series—were continued for two years, and at the time of reporting “three years after the commencement of the treatment the extension has been arrested and the patient has improved greatly in health.”

In another case eight séances of three hours each with 40 mg. of radium caused marked shrinkage and softening of the prostate. Pasteau remarks that they have observed 3 patients in all of whom, when they came under observation, the prostate was enlarged, nodular, and very hard, in whom now the prostate is soft, not adherent, and does not at all resemble cancer. Each of these had only one series of radium application, yet they are reported as remarkably benefited if not cured.

I have tried the urethral catheter method of Pasteau with some success, but have found it inaccurate and unsatisfactory. I accordingly devised (in 1914) radium-carrying instruments of metal, which are capable of being used with a cystoscope, which permits of accurate application of the radium in the bladder and at the vesical orifice. I have also introduced the use of the rectal route for applications upon the prostate and seminal vesicles. After a long series of experiments and treatments I have shown that a great many treatments can be made through the rectum, urethra, or bladder if a new place is selected each time—the sites of the treatments do not overlap.²²

The previous paragraphs are those which have appeared in the

Later after the introduction of the needling method for the treatment of carcinoma of the prostate through the perineum I constructed in the workshop of the Brady Urological Institute an instrument which contains within the beak four needle points each containing 12.5 mg. of radium surrounded by a cap of silver which is surrounded by gutta percha. This instrument was supplied to and is in use by Dr John H. Cunningham of Boston. Fig 315 B shows the needle with shaft attached for insertion through the perineum.

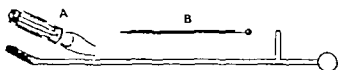


FIG. 315.—New radium applicator with enlarged *A* made to contain four needles containing 12.5 mg. of radium each, which may be used also for needling through the perineum by means of attachable shaft *B*.

Technique Employed.—In the preliminary study of the cases a careful diagram showing the size and consistence of the prostate is made utilizing a rubber stamp outline of normal prostate and vesicles as a basis. In making the examination with the finger of the left hand the outline chart is drawn simultaneously, careful attention being made to get an accurate reproduction of the size and induration of

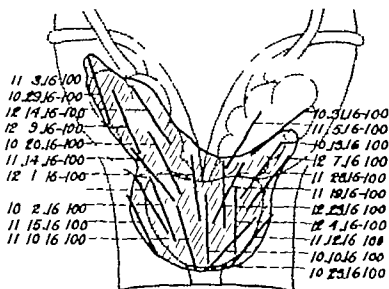


FIG. 316.—Rectal chart showing application of radium to prostate and seminal vesicles.

the mass. The degree of induration is indicated on a scale of four: blank being normal, parallel lines slight induration, cross lines moderate induration, and additional cross lines (at 45 degrees to the other lines) great induration, such as is characteristic of carcinoma. A typical chart of carcinoma of the prostate and seminal vesicles is shown in Fig. 316.

or even against the trigone, as it is possible by simple manipulation to determine where the instrument is in its relation to the vesical neck or to place the radium exactly where it is desired and then hold it there with the clamp. For the rectum the cystoscopic instrument was manifestly not necessary as the radium containing beak could easily be placed at the desired spot along the posterior surface of the

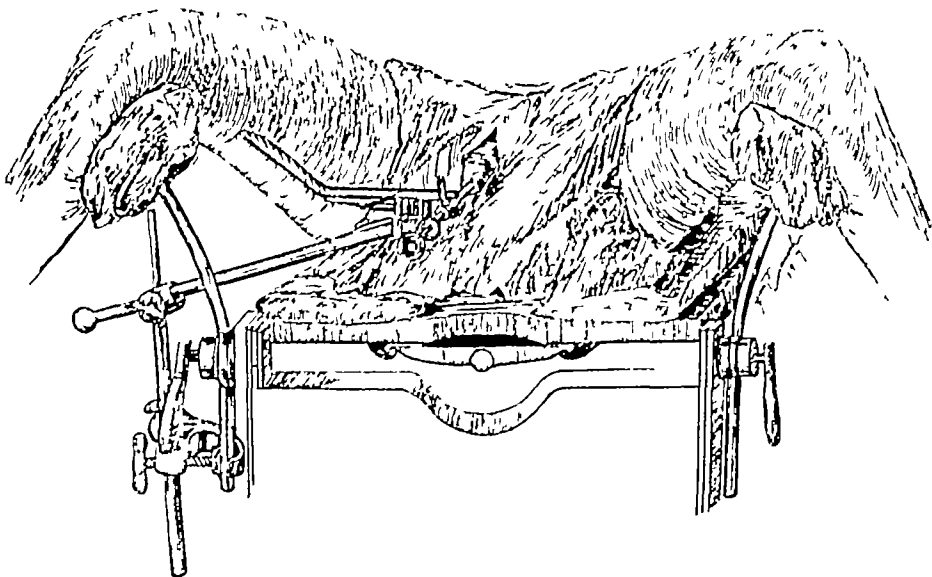


FIG 513 —Mechanical arm and clamp attached to table to hold radium in position

prostate or vesicles or along the pelvic wall and held there by the clamp. We, therefore, constructed instruments of appropriate form not containing cystoscopes for treatment through the rectum, urethra, at the vesical neck or through the trigone and base of the bladder to the region of the seminal vesicles.

Fig 514 shows the present form of instrument which is employed for these treatments. The radium is contained in a small platinum

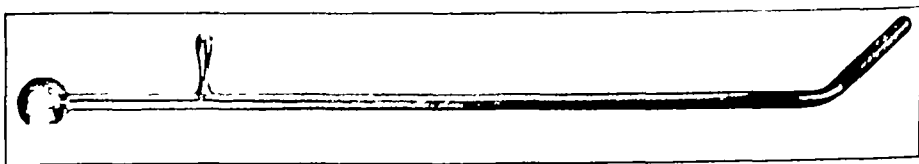


FIG 514 —Radium applicator carrying one or two tubes of radium 100 mg each in platinum tubes, the beak being composed of silver surrounded by gutta percha. Note the fixation ball externally

tube which is surrounded by a silver cap covered with hard rubber, thus affording screening for both the α - and β -rays, and also the secondary rays. The ball is placed at the end of the rod, thus facilitating usage in both rectum, urethra, and bladder, the small handle at right angles to the shaft facilitates operation, and indicates the direction of the beak.

posed by me before the American Urological Association at its meeting in Baltimore 1915 and subsequently presented in a paper has been carried out in over 100 cases the results of which were presented in an accompanying paper by Dr Clyde L. Dunning.*

In my first paper, the charts of cases were presented in which 100 mg of radium was applied for one hour each by rectum urethra and bladder to various positions (Figs 516 and 517). In this case it was given twenty-one times through the rectum and fourteen times through the urethra and bladder as shown. The only modification which has been made in the past four years has been to employ an instrument the beak of which is protected by a gutta percha cap scrupulous care being taken to avoid applying radium twice in the same place gen-

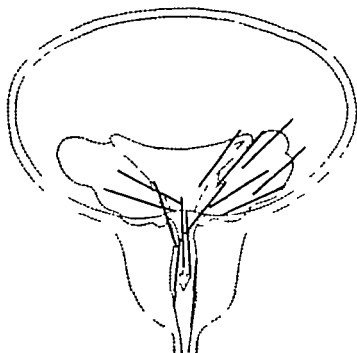


FIG. 517 — Urethral and bladder chart.

erally the successive treatment being given to places quite remote from each other and alternating between the rectum urethra and bladder. Before the introduction of these methods it had been freely stated that it was impossible to employ radium in sufficient dosage through the rectum without producing radium burns. By means of this technique in which the radium is placed in position with the finger in the rectum and held there by the fixation-clamp care being taken to avoid regions that have already been treated before radium burns and even pronounced irritation have been practically eliminated so that we now find it possible to give with impunity twenty treatments one hour each through the rectum with 100 mg properly screened in the small applicator above described. The treatments through the urethra and through the trigone and lateral portions

If the diagnosis is clear from the extreme induration of a portion of the prostate and the absence of calculus from the roentgen-ray examination, a cystoscopic examination may not be carried out. As a rule cystoscopy is much more painful in cases of carcinoma than in cases of hypertrophy, and if it is not necessary for diagnosis we usually do not insist on cystoscopy. If there is a question as to the diagnosis, cystoscopy is performed and is of diagnostic importance, (1) because in cases where no hypertrophy is present, the prostatic orifice usually shows no intravesical lobes or enlargement more than a small median bar or minute rounded lobe, and (2) because there is shown by examining with the finger in the rectum and cystoscope in the urethra a marked increase in the suburethral portion of the prostate, not merely in the prespermatic or subcervical group of glands, but also beneath the entire prostatic urethra from the vesical orifice to the apex, and this increase in the suburethral portion of the prostate is usually associated with marked induration. This is based on the pathological fact that prostatic hypertrophy almost never involves the so-called posterior lobe which lies between the posterior capsule and the ejaculatory ducts above and the lower portion of the prostatic urethra below, and that the same region is strangely the point of predilection for carcinoma. The diagnostic sign was first pointed out by us in 1906,¹⁶ and has been of great value in the diagnosis of early and doubtful cases.

The diagnosis of carcinoma having been made, the question arises as to whether a radical operation can be carried out with the probability of success.

Experience has shown that in cases in which the carcinoma is confined well within the capsule of the prostate, in which it has involved only the lower portion of one or both seminal vesicles, and in which it has not penetrated the prostatic capsule or fascia of Denonvillier, which covers not only the prostate but the seminal vesicles, the radical technique can be carried out with strong probability of a complete cure and a functioning bladder with perfect control and without urethral stricture at the site of anastomosis.

Unfortunately, the great majority of cases present themselves much too late, the disease has already progressed well up along the sides of the seminal vesicles, and frequently involves the lower pelvic glands, often forming a plateau of marked induration above the prostate in the intervesicular region. In many of these cases there is no marked urinary disturbance beyond a slight residual and some increased frequency, owing to the fact that carcinoma of the prostate tends to invade the structures above, behind the bladder, and does not penetrate or ulcerate until later into the urethra or bladder. On this account operative relief for the obstruction is usually not necessary, and one is free to choose methods of attack upon the carcinoma, which is usually producing symptoms due to its size and pressure upon nerves and adjacent structures. The plan of procedure for thorough treatment of cancer of the prostate with radium, which was first pro-

posed by me before the American Urological Association at its meeting in Baltimore 1915 and subsequently presented in a paper has been carried out in over 100 cases the results of which were presented in an accompanying paper by Dr. Clyde L. Denning.*

In my first paper, the charts of cases were presented in which 100 mg. of radium was applied for one hour each by rectum, urethra and bladder to various positions (Figs. 516 and 517). In this case it was given twenty-one times through the rectum and fourteen times through the urethra and bladder as shown. The only modification which has been made in the past four years has been to employ an instrument the beak of which is protected by a gutta serena cap, scrupulous care being taken to avoid applying radium twice in the same place, gen-

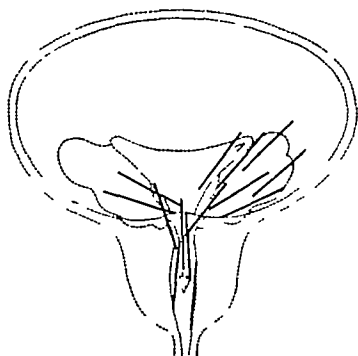


FIG. 517.—Urethral and bladder chart.

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of the base of the bladder are of very great importance, as only the mucous membrane and submucous tissues separate the radium from the carcinomatous prostate or vesicles. Since the introduction of Barringer's needles we have often added this method of treatment to our routine technique, and now employ two needles at a séance, each of which, containing 12.5 mg., is inserted through the skin of the perineum (which has been cocaineized) into one or both prostatic lobes or even into the carcinomatous mass above the prostate or along the lateral wall of the pelvis in the region of the seminal vesicles. These needles are usually allowed to remain in place for a period varying from eighteen to twenty-four hours. They are introduced under the direction of a finger in the rectum (which should not be covered with glove or finger cot in order to be acutely sensitive to

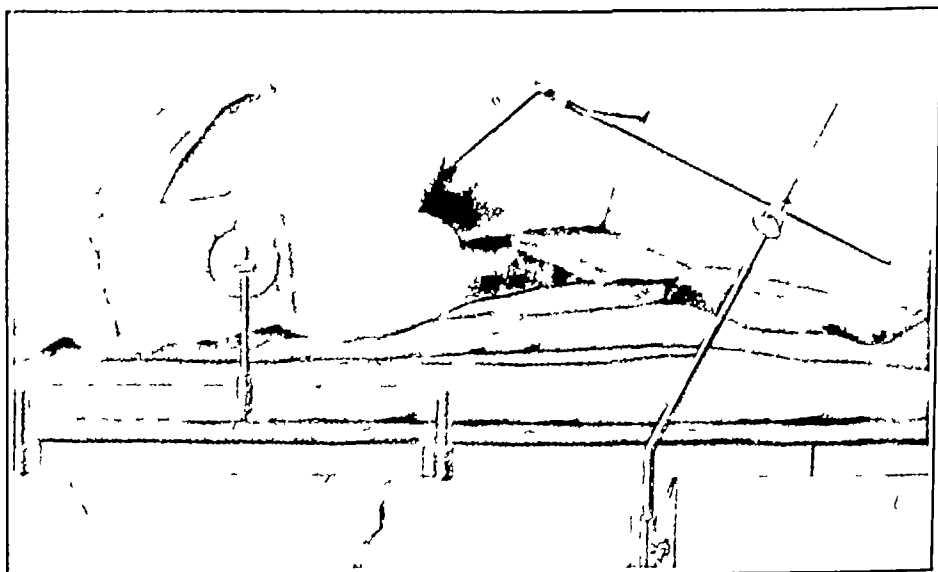


FIG. 518.—Technique for radium application to posterior surface of prostate and vesicles with applicator introduced through anus and held in place by clamp attached to table

the exact position of the needle). This procedure may be repeated several times during the first series of treatments and adds a valuable amount of radiation to the central portions of the prostate and seminal vesicles where it is most remote from the radium applied through urethra, bladder, or rectum. As at present given, one complete series consists of an hourly treatment of 100 mg. of radium properly screened and applied with the special applicator alternately twenty times (one hour each) through the rectum, ten times through the urethra, and ten times through the trigone and also 12.5 mg. several times through the perineum. As noted before in these regions there is sufficient area to provide for treatments which do not overlap or repeat at the same spot and therefore do not produce ulcerations. With such a series of treatments most amazing resorption of extensive carcinomatous involvement of prostate and seminal vesicles and tissue

adjacent to them is obtained in the majority of cases and along with it there comes a disappearance of pain and obstruction a return usually to more normal urination and freedom from straining which is indeed remarkable. Fig. 518 shows radium applied through the rectum with patient upon his side and the clamp in operation. Fig. 513 shows the instrument in place for treatment of the urethra or bladder.

I have constructed an applicator (Fig. 512) which carries in the beak two tubes of radium 100 mg each placed end to end and thoroughly screened with 2 cm. of platinum and a thin layer of gutta serena. This materially shortens the treatment as 200 mg. hours is given each hour with this applicator instead of 100 mg. hours.

Details of Treatment.—Before mounting the table the patient should empty the bladder and if necessary evacuate the bowels. For treatments through the rectum no anesthesia is necessary. For the urethra and bladder the instrument is sterilized with alcohol the urethra is sterilized with 1 to 500 Merocyl and it is well to inject 4 per cent procaine before the introduction of the radium applicator. In very painful cases it may be desirable to give $\frac{1}{2}$ grain of morphine or opium suppository one-half hour before treatment. In some cases treatments can be given twice a day, but usually the patient objects and one treatment of one hour each day is all he will take. We usually alternate between urethra, rectum and bladder picking each time a region which has not been previously treated. The record of treatment is made upon either the prostatic or urethral and bladder chart as shown in the accompanying Figs. 516 and 517. A line is drawn showing exactly where the radium was applied and the date and amount is indicated on the line which points to the site of application. The treatments through the perineum with needles is indicated in a similar way upon a third chart thus the entire treatment is recorded simply upon one page and the operator can determine at once the location to be treated next in order to avoid overlapping and consequent burning. Another series of rectal charts four in number are made two weeks apart. These show the progress of the case and often demonstrate the remarkable disappearance of extensive infiltration and induration as shown in some of the cases charted below. In a certain proportion of our cases probably 10 per cent obstruction persists and the presence of residual urine and frequent urination necessitated operative removal of the obstruction. In these cases I have pursued a plan which I have employed in carcinoma of the prostate (associated with hypertrophy or with great obstruction) since 1905 viz conservative perineal prostatectomy with enucleation of the obstructing median and lateral lobes and careful preservation of the urethra and ejaculatory ducts. Almost invariably the patient is given as thorough a treatment as possible with radium through the rectum, urethra and bladder before the prostatectomy is carried out. During this course of radium treatment in many cases the obstruction disappears but in others operation is necessary and the results obtained are generally functionally as good as in benign

hypertrophies In some cases radium is introduced into the prostatic cavities only at operation, but care must be taken to protect the rectum by sponges and rubber protective which holds the radium sufficiently far away from the rectum Sufficient radium should be on hand to thoroughly treat the remaining urethra, neck of bladder, lateral capsules and region of seminal vesicles. I usually use two tubes of 100 mg each, two needles of 25 mg each and two needles of 12.5 mg each after enucleating the prostatic lobes The tubes of 100 mg remain six hours (1200 mh), the needles of 25 mg twelve hours (1200 mh) and the needles of 12.5 mg twenty-four hours (1200 mh)

Ultimate Results of Radium Treatment in 100 Cases of Cancer of the Prostate and Seminal Vesicles Without Operation by Rectal and Urethral Applications — (From a very careful and extensive study made by Dr C. L. Deming⁶ of our cases at the Brady Institute) Symptomatically, the results from radium have been most remarkable, as will be shown by the tables which I have taken from Deming's report

SIXTY-FIVE CASES RECEIVED ONLY ONE SERIES OF TREATMENTS RESULTS OBTAINED

Average milligram hours	No cases	Symptoms	Size of prostate	Percentage improved	Percentage not improved
625	26	No response	No change	0	100
999	39	Improved	No change	60	40
1415	16	Improved	Decreased	77	23

It will be seen that those cases which showed no response to radium received the smallest amount of treatment Among 65 cases there were 12 in which the patient received between 1600 and 2975 mg hours of treatment, and in all these cases the improvement of symptoms and the regression of the enlargement and induration of the prostate was very marked, whereas in 30 cases who received less than 1000 mg hours of treatment, only 1 showed any improvement in the condition of the prostate, although in 13 there was a slight improvement in the symptoms Among 18 cases who were subjected in two series of radium treatments, there were only 10 that received 1600 mg hours or more, and 6 of these cases showed wonderful improvement both in symptoms and in the induration and size of the prostate, all but 1 who received over 2000 mg hours were greatly benefited There were 8 patients who received 1500 mg hours or less and only 2 of these showed even a slight change in the prostate and vesicles, although the symptoms were improved in all but 3 cases One patient received 4600 mg hours and another 5270 mg hours without any rectal or urethral irritation and with apparent cure of symptoms and complete reduction in the size and induration of the prostate

In another group of 10 cases which were subjected to three series of radium treatments, a study of results showed that where each series was small in total mg hours, although the total might be over

2000 mg hours the results obtained were ineffective. Three of these cases, receiving 2100, 2760 and 3200 mg hours respectively, were apparently cured as to symptoms and the size and induration of the prostate greatly improved. The same was true of 5 cases who received four series and 2 cases which received five series of radium treatments.

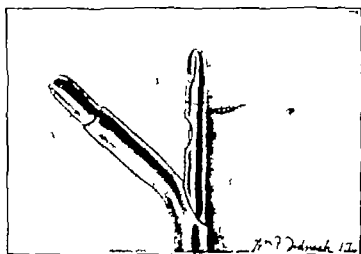


FIG. 519.—Showing use of radium in bladder with Young's cystoscopic radium applicator to cancerous infiltration of trigone.

all but 3 totaling 8000 mg hours or more. In all of these the results obtained as to symptoms and reduction in the size of the prostate was said to be 100 per cent. One of these patients received 6225 mg hours with only slight rectal and urethral irritation.

During the past two years I have given the treatments more frequently if possible every day and occasionally twice a day.



FIG. 520.—Chart showing involvement on admission, April 21, 1921, after 2700 milligram hours, June 6, 1921, and after 4200 milligram hours, June 15, 1921.

Eight of these patients received 4000 mg hours or more with nothing more than slight irritation resulting. This effectually answers the criticism of those who advise against the use of radium in the rectum and urethra on account of burns. The technique must be intelligently carried out so as not to apply the radium twice in the same place. Fig. 520 shows most graphically the improvement obtained in one case.

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In another group of 10 cases which were subjected to three series of radium treatments, a study of results showed that where each series was small in total mg hours, although the total might be over

12 Thus far we have no actual proof that radium has produced an actual cure for cancer of the prostate and seminal vesicles although 3 cases have remained free from symptoms and tumor growth for more than four years and many others show on rectal examination a condition of the prostate which does not now resemble cancer.

Denning also made a very careful study of 33 cases in which the use of radium was combined with perineal prostatectomy and I quote as follows:

Histological Picture—Study of the specimens removed at operation is the only method of deducing accurate conclusions regarding the effect of radium.

The action of radium has been found to be of two kinds: (1) A gradual disappearance of the cancer tissue and the development of fibrous tissue and (2) necrosis.

The gradual changes produced by radium have been well described by Young and Frontz,²⁷ and Alter. The effect of radium does not correspond in all cases to the amount of radium given. Some tissues show marked changes while others show little change that can be ascribed to radium. The periphery of the specimens naturally shows the first evidence of radiation. Different conditions of degeneration can be easily seen in many of the specimens such as pyknosis of the nuclei, vacuolization, shrinking of the cytoplasm and in some cells a few poorly stained granules. Other cells show granules taking very deep stain. Increase in fibrous tissue is a prominent factor in most of the sections. It is firm, the strands are packed tightly together and form a dense hard tissue. Between some of the layers of fibrous tissue small darkly stained granules or outlines of a few cancer cells may be seen indicating complete destruction of the cancer with development of fibrous tissue.

In all the cases treated with extraglandular methods no necrosis of tissue was found. Whenever a change occurred it was a picture of gradual melting away of the cancer tissue and a development of fibrous tissue. One specimen had been treated intraglandularly with two needles. Each needle contained 12.5 mg. of radium and was allowed to remain in position for twenty-four hours. The operation occurred two weeks later. Sections from this specimen showed necrosis of all the tissue within a radius of 4 mm. The connective tissue stroma as well as the cancer forms a necrotic area. No such areas have been seen in the other specimens although some received 4000 mg. hours.

The results obtained by operation plus radium are stated by Denning to be as follows:

Four patients are alive and apparently well three years after operation. Twelve per cent have an excellent result. Sixty-six per cent are improved and 21 per cent unimproved and still have difficulty in urination and palpable cancer of the prostatic tissue. Of the 33 cases 51 per cent have died within twenty-two months, the average being eleven months after operation. All had metastasis. Those cases in which good results were obtained received a combination of radium before operation 2000 to 3000 mg. hours and after operation 1000 to 2000 mg. hours. Rectal examination two years after operation showed no return of carcinoma.

A Method of Implantation into Prostate and Vesicles—A patient who presented himself in November 1921 (No. 10 109 B U I) complained of no obstruction to urination but although the carcinoma involved both seminal vesicles and the membranous urethra to an extent which made radical operation impossible it seemed wise to do something

Although many of the 100 cases analyzed by Deming, as stated above, received very inadequate amounts of radium (65 receiving less than 1500 mg hours, which has been shown to be too little to be of much value) the following table shows the really remarkable effect upon the various symptoms presented by these patients

IMPROVEMENT IN SYMPTOMS

Symptoms	Before treatment	Result of treatment		
	Percentage present	Percentage entirely relieved	Percentage improved	Percentage unimproved
Frequency	96	57 0	25	18 0
Nycturia	95	57 0	25	18 0
Dysuria	80	90 0	—	10 0
Hematuria	17	100 0	—	—
Hesitancy	65	80 0	7	13 0
Dribbling	76	75 0	5	20 0
Small stream	87	74 0	6	20 0
Complete retention	21	95 0	—	5 0
Residual urine	61	85 0	12	3 0
Pain in back	28	60 7	—	39 3
Pain in extremities	22	59 0	—	41 0
Loss of weight	14	57 1	—	42 9

Of these 100 cases, only 2 developed ulceration of the rectum, 1 a recto-urethral fistula, but both were apparently cured by the radium treatment. "With the intensive treatment now used, no ulcerations have developed and the patient is able to tolerate 4000 mg hours or more. Frequently the patient passes mucus and has from two to four stools a day with discomfort or tenesmus, but these symptoms finally disappear. There have been no severe systemic reactions with nausea, vomiting or temperature." Deming's conclusions are as follows:

1 Radium gave symptomatic relief and return of normal urination in 75 per cent of the cases

2 Radium relieved the pain in the back in 50 per cent of cases suffering from metastases

3 Irritation from radium can be avoided by treating widely remote areas in successive treatments and by alternating between rectal, urethral, and vesical applications

4 At least 1000 mg hours must be given to produce any symptomatic improvement

5 Fourteen hundred mg hours must be given to produce any perceptible change in the tumor mass

6 Three thousand mg hours must be given to produce symptomatic and local results in the same patient

7 Four thousand and 5000 mg hours in a period of six to eight weeks should be given if possible, in addition to needle treatments of 500 to 2000 mg hours through the perineum

8 Case which did not respond to radium did not receive sufficient radiation

9 Large doses must be given in as short a period as possible to produce maximum results

10 No general systemic reactions have been encountered

11 Combined extraglandular and intraglandular radiations apparently give the most satisfactory results.

needles small glass tubes each containing 1 mc. of radium emanation (Fig 521) These were placed so that all the needles would be 1 cm. apart, and an effort was made to cover the entire substance of the prostate seminal vesicles tissues between as well as adjacent apparently uninfected tissues above and around the regions involved. About

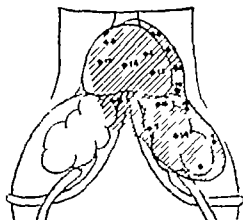


FIG. 522.—Diagram showing location of radium implantations, some superficial, some deep in the prostate and left seminal vesicle

16 emanation points were thus used the result being as shown in Fig 522 in which it is difficult to show the depth to which some of the needles were placed. No portion of the prostate or seminal vesicles was excised as the patient at that time had no difficulty of

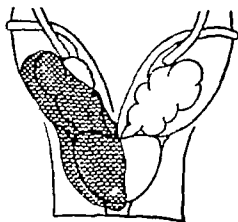


FIG. 523.—Prostate on rectal examination before operation. Note triple degree of induration of left lobe of prostate and left vesicle

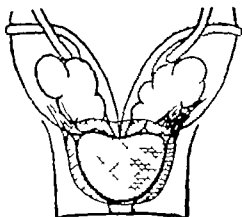


FIG. 524.—Condition found on rectal examination six months after treatment. Note complete disappearance of infiltration in region of left vesicle and left lobe of prostate

urination. The wound was lightly packed with gauze and rubber protective so as to keep the radium bearing area well away from the rectum and the skin was closed with a small area for drainage.

The results obtained are graphically shown in the two charts before operation and six months later (Figs 523 and 524). As seen here the

more radical with radium than I had ever employed before. I therefore carried out the following procedure. The prostate was exposed as for perineal prostatectomy but with my long urethral prostatic tractor in the bladder to draw down the prostate, thus avoiding the necessity of opening the membranous urethra for this purpose. By blunt dis-



FIG. 521.—Implanting radium into prostate and seminal vesicles after exposure through perineum without opening urinary tract. Young's long prostatic tractor used to draw down the prostate and vesicles.

section the whole posterior surfaces of the seminal vesicles and the space between them were exposed, a good view being obtained by deeper retractors placed obliquely in the two lower angles of the wound which was a little longer than in the prostatectomy operation. Palpation showed it was possible to get well about the upward limits of the carcinoma on each side, and I then proceeded to insert with

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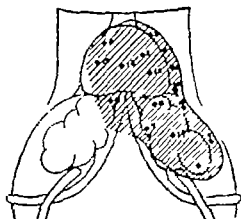


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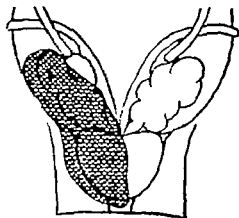


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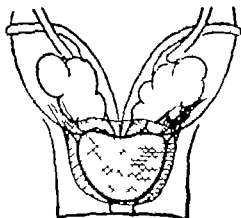


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looked well, had no residual urine and his urinary function is good (Case probably followed about one year but results remarkably good)

COMMENT—The method described by Herbst has the advantage of accuracy and ability to insert a large amount of radium over a large area. With the use of such large tubes (12 mc. for twelve hours) the possibility of marked necrosis particularly of the vesical mucosa is to be thought of. No subsequent report of cases and ultimate results has been made.

Bugbee² makes a brief report detailing recent cases in some of which the rectal, urethral and vesical applications described elsewhere were employed and also with radium needles which have been introduced through a suprapubic wound which Bugbee has found the most effective especially when combined with radium needles through the perineum and applicators introduced per rectum.

Bumpus in a report of 217 cases treated by radium states that about 600 mg. hours represents the maximum safety in rectal applications (which is to be explained by his use of the fenestrated bougie in making the rectal applications).

Thirty-seven patients were treated by inserting needles directly into the gland through the perineum. The average dosage was approximately 2000 mg. hours. Completed records of 27 patients show that they lived an average of fourteen months after treatment and that the duration of the disease from the onset was forty five months slightly longer than the average for patients not treated. These poor results are explainable by the fact that by abandoning the rectal and urethral applications the periphery of the growth where the greatest cell activity occurs was not thoroughly irradiated. The needles were allowed to remain long enough in one location to destroy the malignant tissue immediately around them but the tissue was only slightly affected beyond. The radium rays like light, diffuse as they leave their source and their effect diminishes progressively. Therefore, instead of stimulating fibrosis and hyalinization the natural barriers of malignancy destruction of only limited areas of malignant tissue had resulted. At the Memorial Hospital, New York, results of the work with buried emanation tubes have shown that 0.5 mc. of emanation, when buried in tumor tissue affects an area approximately 1 cm. in diameter and that to increase this dosage to three or four times this amount does not increase the area irradiated appreciably but causes marked destruction of cancer tissues with resulting necrosis. Each 0.5 mc. emits 60 mc. hours this is equal to a needle containing 12.5 mg. radium in place for five hours. Therefore keeping needles containing 12.5 mg. in one position for from twelve to twenty-four hours causes localized necrosis and sloughing. The desired minimal dosage is obtained by leaving a needle bearing 12.5 mg. of radium in one position for five hours and then withdrawing it 12 mm. the length of the radium bearing portion in order to irradiate a second area 1 cm. in diameter. By using four needles at once and changing their position three times, twelve such areas, or twenty four areas in two treatments will be irradiated affording approximately 1500 mg. hours of irradiation. If to this, 600 mg. hours in the rectal exposure and 400 mg. hours in the urethral exposure are added the maximum of malignant tissue is affected. In this way it is possible to avoid the necessity of giving from 4000 to 5000 mg. hours of exposure, with the danger of slough and fistula formation, and the so-called radium reactions incident to heavy dosage which are really due to absorption of the toxic necrotic tissue destroyed. It has been our experience that approximately 2500 mg. hours is the maximal dose that may be safely given even in the largest glands without producing sloughs.

2 ounces of residual urine, but died of renal infection. The fourth patient left the hospital emptying his bladder.

Barringer's conclusions are: "The results of radium treatment for carcinoma of the prostate are superior to operative removal both in causing regression of the disease and in coping with urinary retention."

COMMENT—Considering the fact that Barringer's reports cover a period of six years and the series of 145 cases, results are not, I believe, very satisfactory with the exception of the 4 cases apparently cured, detailed above, which are really brilliant cases. Based on my experience I am convinced that much can be accomplished, certainly by additional treatments through the rectum, urethra and trigone, as detailed elsewhere, if care is used not to apply in the same place and thus avoid burns.

In 1919, Herbst⁸ advocated implantation of radium-containing needles directly into the prostate through a suprapubic or a perineal wound. "Suprapubic cystostomy is made with a liberal opening in the bladder, bimanual examination is then made to determine the limits of the tumor, by means of a metal carrier, gold needles containing 12 mc of radium are inserted into the tumor mass 1 cm apart in different directions. The tumor is converted into a pin-cushion. A silk guide is attached to each needle and brought out the suprapubic wound, and at the end of twelve to fifteen hours the needles are removed by traction on the silk guide. One such exposure would usually cause the removal of most of the upper part of the tumor, although this can be repeated in a few weeks if found necessary. As most of the tumor begins in the lower part of the gland, a second introduction of needles is made by making a dissection through the perineum and obtaining an exposure of the lower part of the prostatic mass. It is well to make the upper exposure first and the perineal four to six weeks later. The number of cases treated has been limited and the duration short."

One case was reported which had been subjected to prostatectomy and the tissues found malignant. The patient was treated by radium per rectum and urethra without results and then later seen by Herbst who found an irregular, hard, nodular mass in the region of the prostate with almost complete retention of urine. Through a suprapubic incision eight needles were inserted into the prostatic tumor about 1 cm apart in different directions and allowed to remain twelve hours. There was practically no reaction. After six weeks the upper part of the mass had almost entirely disappeared. At this time a perineal section was made thoroughly exposing the lower part of the tumor and the needles were inserted, and allowed to remain in place for twelve hours, exact number of needles is not stated.

Both suprapubic and perineal wounds healed in a few weeks. "After a few months all that could be palpated was a moderate degree of induration along the urethra. Recently examination showed only slight infiltration at the site of the tumor, he had gained in weight,

Résumé—The present situation as regards the treatment of cancer of the prostate may be summarized as follows (1) When the carcinoma is sufficiently early for the radical operation the chances of a cure are excellent probably over 60 per cent with good functional results. In later stages the use of radium alone in the form of emanation points 1 mc. each and implanted into the surface of the prostate and seminal vesicles and adjacent uninvaded tissues promises splendid results which have not been borne out by time. (2) The use of radium, applied with Young's rectal urethral and cystoscopic applicators through the rectum urethra and trigone has given fairly good results both in the relief of symptoms and diminution of tumor mass. If possible, over 3000 mg. hours should be given in a series of daily treatments, and often no further treatment will be indicated. Unless hypertrophy of the prostate is present more or less lessening of obstructive symptoms may be expected. (3) Cases with considerable prostatic hypertrophy or with more or less complete retention of urine will usually require transurethral resection or punch operation. In such cases by either partial or subtotal prostatectomy extraordinary results both as to cure of symptoms and disappearance of tumor mass are sometimes obtained. The use of radium needles has been shown by Barringer to be of great potency. (4) The prostate is more frequently involved in carcinoma than any other internal organ. The diagnosis can often be made early and radical cure obtained by thorough operation in which the entire prostate cuff of the bladder and seminal vesicles are removed in one piece. (5) The perineal route is the only one by which early diagnosis can be confirmed and radical cure obtained. (6) If the medical profession could be made to realize the frequency and importance of early diagnosis and urge patients over fifty years of age to come for occasional examination at which a careful rectal with palpation of the prostate, and search for a hard nodule may be carried out many more early cases of cancer of the prostate would be recognized and cured.

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On the supposition that the poor results obtained from the use of rectal and urethral exposures alone, or from the use of needles alone, was attributable to the fact that not all of the cancer cells were reached by the radium emanations, the last 127 patients were treated by a combination of the three methods. The completed records of 83 patients show that the average dose of radium was 1960.45 mg. hours. Sixty patients (72.28 per cent) are dead, they lived an average of eleven and a quarter months after treatment, 66 per cent died the first year. The duration of the disease in the patients who died (thirty-three and two-thirds months) is approximately the duration of the disease in the untreated patients, 23 (27 per cent) are alive, the duration of the disease having increased to forty-seven and a third months, and the time since their last treatment to twenty months, an extension approximately of one year in each.

Since only 8 of the 217 patients treated with radium are alive after three years, it will be seen that the results are far from satisfactory. However, the average extension of life for one year as a result of the combined method of administration is significant, and demonstrates that by careful selection of cases and care in irradiating all portions of the gland, better results may be expected in the future. The fact that 27 per cent of the living patients are now in their third year after treatment, and that a number do not show evidence of malignancy either by palpation or any symptoms, while only 8 per cent of untreated patients survive to their third year, prevents the abandonment of this form of therapy. The results emphasize, however, that the treatment is applicable only to a selected few, to apply it to all patients with carcinoma of the prostate is to encourage false hopes and cause results disheartening to both patient and physician.

The writer believes that Bumpus' results show the greater value of my plan of applying radium through the rectum, urethra and bladder. The fear of radium burns per rectum which caused him to limit the rectal treatment to 600 mg. hours could have been obviated by the use of the fixation-clamp and special applicators. My cases receive generally three times as much radium per rectum (1800 mg. hours or more) without burns.

The Use of Deep Roentgen-ray Therapy of High Voltage — The treatment of metastases, particularly to the bones, often requires special attention. This is particularly true when it is associated with severe pain in the back, hips or extremities. In a few instances, massive doses of radium have been applied with some benefit, but recently (prior to 1924) Dr. C. A. Waters has treated some of my cases with deep roentgen-ray therapy, using about 200,000 volts, which is directed through 10 or 12 limited portals of entry, each for a sitting of about one hour and on succeeding days, if possible. The reaction obtained is sometimes considerable and prostration, loss in weight and diminution in hemoglobin is not infrequently very perceptible, showing the necessity of great caution and particularly the need of limiting the portals of treatment, especially where the intestines are exposed. Really extraordinary results in the relief of pain have been secured in some of my cases, and it seems justifiable to predict that great advances will be made with the use of the roentgen-ray, and perhaps by a combination with radium even better results than those now obtained will be secured.

CHAPTER XX

SARCOMA OF THE PROSTATE

By HUGH HAMPTON YOUNG M.D. F.A.C.S. Hon. F.R.C.S.I.

THE first case of sarcoma of the prostate was described by Stafford in 1839 a melanotic tumor in a child five years of age. In 1858, Thompson found 6 cases in the literature and in 1902 Burekhardt was able to collect 24 cases. Proust and Vian in 1907 published 34 incontestable cases and in 1909 Gibson collected reports of 37 cases. Parmenter was able to find 59 cases in 1917. In 1920 Quinby reported an additional case corroborated by operative and pathological findings.

In the first edition of this system of urology I reported 1 case and analyzed 30 cases which I found in the literature as follows:

Age—In the 30 cases in which the diagnosis has been confirmed by the microscope 15 were under ten years of age, 12 were between ten and forty-nine years of age, and 8 were between fifty and eighty years of age. In 4 cases the patient was less than a year old and 3 patients were between seventy and seventy-three years of age.

Various types of sarcoma have been present viz: small cell 6, large cell 3, spindle cell 5, polymorpho cell 4, lymphosarcoma 2, angiosarcoma 2, myxosarcoma 3, adenosarcoma 1, chondrosarcoma 1, rhabdomyoma 3, fibroid 1.

The tumor soon reached considerable size and in some places almost completely filled the pelvis. It was usually oval in form, regular or slightly lobulated, but occasionally irregular and nodular. The consistence was variable, sometimes firm, sometimes elastic, sometimes so soft as to give the sensation of fluctuation. In many cases, however, the induration was considerable. The bladder was generally pushed upward and forward by the tumor, which grew backward beneath the base of the bladder. The mucous membrane was generally intact, but occasionally small papillomatous intravesical outgrowths were present, almost always in the region of the trigone. The rectum was usually compressed, flattened, but its walls were rarely infiltrated and the mucous membrane was healthy in all cases. The urethra was almost always invaded and generally strictured. Occasionally intra-urethral polyps were present. The seminal vesicles have generally been found involved. The perirectal and retroperitoneal tissues were often invaded, as were also the peritoneum, the intestines and the pelvic bones. The lymph glands were involved in 7 of the 30 cases, but metastases elsewhere occurred more frequently.

That sarcoma of the prostate is a rare disease is shown by the fact that only 1 case has been detected among the immense number of cases

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CHAPTER XX

SARCOMA OF THE PROSTATE

By HUGH HAMPTON YOUNG M.D. F.A.C.S. Hon. F.R.C.S.

THE first case of sarcoma of the prostate was described by Stafford in 1830 a melanotic tumor in a child five years of age. In 1858 Thompson found 6 cases in the literature and in 1902 Burekhardt was able to collect 24 cases. Proust and Vian in 1907 published 34 incontestable cases and in 1909 Gibson collected reports of 37 cases. Parmunter was able to find 59 cases in 1917. In 1920 Quimby reported an additional case corroborated by operative and pathological findings.

In the first edition of this system of urology I reported 1 case and analyzed 35 cases which I found in the literature as follows:

Age—In the 35 cases in which the diagnosis has been confirmed by the microscope 15 were under ten years of age, 12 were between ten and forty-nine years of age, and 8 were between fifty and eighty years of age. In 4 cases the patient was less than a year old and 3 patients were between seventy and seventy-three years of age.

Various types of sarcoma have been present viz. small cell 6 large cell, 3, spindle cell 5 polymorphio cell 4 lympho-sarcoma 2 angio-sarcoma 2 myxosarcoma 3 adeno-sarcoma 1 chondrosarcoma 1 rhabdomyoma 3 fibroid 1.

The tumor soon reached considerable size and in some places almost completely filled the pelvis. It was usually oval in form regular or slightly lobulated but occasionally irregular and nodular. The consistence was variable sometimes firm sometimes elastic sometimes so soft as to give the sensation of fluctuation. In many cases however the induration was considerable. The bladder was generally pushed upward and forward by the tumor which grew backward beneath the base of the bladder. The mucous membrane was generally intact but occasionally small papillomatous intravesical outgrowths were present, almost always in the region of the trigone. The rectum was usually compressed flattened but its walls were rarely infiltrated and the mucous membrane was healthy in all cases. The urethra was almost always invaded and generally strictured. Occasionally intra-urethral polyps were present. The seminal vesicles have generally been found involved. The perirectal and retroperitoneal tissues were often invaded as were also the peritoneum, the intestines and the pelvic bones. The lymph glands were involved in 7 of the 35 cases but metastases elsewhere occurred more frequently.

That sarcoma of the prostate is a rare disease is shown by the fact that only 1 case has been detected among the immense number of cases

seen at the Hôpital Necker in Paris. I have personally had 1 case in which the diagnosis of sarcoma of the prostate was positively made by microscopical examination, but in our service there have been 3 cases in which a clinical diagnosis of sarcoma has been made. My patient, a man, aged fifty-one years, had suffered with pain in the lower abdomen and rectum for fourteen months. Urinary trouble had been present for six months, but had only recently become marked. On rectal examination an immense smooth mass, which almost filled the pelvis, was felt. It was very soft and homogeneous to the touch and almost completely obliterated the rectum. Only 40 cc residual urine was present. Perineal prostatectomy was performed and the tumor found to spring from the upper portion of the prostate, the anterior two-thirds of which was apparently normal. The urethra and bladder were not invaded, but the latter was greatly elevated by the huge retrovesical mass. The tumor was composed of soft hemorrhagic material which was easily scooped out with the finger. The patient recovered and was able to void urine without difficulty and lived for almost a year. The microscope showed a sarcoma of mixed-cell type.

In 1927¹ we made an analysis of 20 cases of sarcoma of the prostatic-vesicular region from the records of the Biadv Urological Institute. We showed that proven cases of primary sarcoma of the prostate alone are extremely rare. It was necessary to make a distinction between primary prostatic sarcoma and sarcomatous growths which are retrovesical, which do not arise from the prostate, but may involve it later. A case, to be proven, must be substantiated by histological evidence. Culver collected 76 cases, and the following year Smith and Toigerson presented an analytical study of 84 proven cases. The same year Kietschmer reported 2 more, making the total of 86 authentic cases from the literature. Although microscopic examination of the tissues, showing sarcoma, has been made in all these cases, it is not clear that the tumor began in the prostate. I believe they should be grouped as "sarcomata of the prostate and its adnexa," no attempt being made, except in those cases which are small and definitely confined to the prostate, to say where they begin, or to try to call them strictly sarcomata of the prostate. Smith and Toigerson found that 30 per cent of the cases occurred in the first ten years of life, and 70 per cent during the first forty years, therefore, before the age of hypertrophy of the prostate. In only 20 per cent of the cases does sarcoma occur in men over seventy years of age.

The round cell sarcoma was found in 36 per cent of the cases, and the spindle cell in 20 per cent. Other types found were rhabdomyosarcoma, myxosarcoma, mixed cell, lymphosarcoma, angiosarcoma, fibrosarcoma, chondrosarcoma, adenosarcoma, leiomyosarcoma and giant-cell sarcoma.

In 1934 Cole and Martin¹ studied the literature on primary lymphosarcoma of the prostate and found only 4 authentic cases. Many other reported cases of primary lymphosarcoma of the prostate resem-

¹ Jour. Urol., 31, 803, 1934.

bled small or large round cell sarcomata which on careful study could be classified as highly anaplastic carcinomata. They point out that sarcoma of the prostate may metastasize to the regional lymph nodes and viscera but not to the bones in contradistinction to carcinoma. The positive identification of their case was furnished by the metastatic invasion of the pancreas which was purely lymphosarcoma but they think that Fwing's statements relative to round-cell sarcomata of the prostate which lack radiosensitivity cast doubt as to whether such cases may not be highly anaplastic carcinoma. Randall and Hughes, Fwing, Boyd and Symmers all stress the fact that no lymphoid tissue is to be found in apparently normal prostate glands but none consider it impossible.

Gilbert¹ reports 1 case of spindle-cell tumor in a boy aged eighteen years and another case of myosarcoma in a patient aged sixteen years. In these cases Gilbert had difficulty in differentiating them from prostatic abscess. His report is accompanied by a very complete study of the literature.

Symptoms.—Proust has divided his study into those of early age 24 cases and those of advanced age 10 cases. Among these of early age the first symptom was usually pain and this did not come on until obstruction to urination developed. Constipation was often present. In most cases the tumor had reached great size before any symptoms were present. Among those patients older than thirty years of age the development was slower. In rare cases sudden retention of urine occurred but often there was very little obstruction to either urine or feces. At times owing to its softness it is difficult to differentiate from abscess. In the adult sarcoma of the prostate is generally more irregular than hypertrophy, produces less lengthening of the canal and is more infiltrating. Sarcoma is less often accompanied by hematuria than carcinoma which is usually much harder and characterized by indurated prolongations into the region of the seminal vesicles. In my case the consistence was much softer than is ever seen in simple hypertrophy and the immense smooth, globular mass could never have been mistaken for carcinoma. In a recent study of 20 cases of sarcoma at the prostatic-vesical region I found the symptoms varied considerably according to the extent and direction of the growth. In many cases the tumor was quite large before any symptoms developed. Pressure upon the urinary tract and rectum results in difficulty of urination and defecation. When the bladder floor is greatly elevated by the large retrovesical mass the bladder capacity may be greatly reduced and urination become frequent. When ulceration of the vesical and urethral mucosa occurs, hematuria is present. If the growth is very extensive irritation of the sacral nerve roots may occur resulting in severe lancinating pains in the sacrum and along the course of the sciatic nerves. Edema of the lower extremities frequently occurs. Obstruction of the ureters by the retrovesical growth may lead to great

dilatation and impairment of renal function. Cachexia eventually develops.

Diagnosis — When the sarcoma has originated in the prostate itself, the diagnosis from other tumors of the prostate is sometimes quite difficult. In a few cases the induration has been almost as hard, and the surface as irregular as in carcinoma of the prostate. Ewing believes that some of the cases diagnosed sarcomata are really soft carcinomata. When the tumor is elastic in type and grows upward into the lateral and median portions of the prostate, and produces lobes which project into the bladder, the diagnosis from benign prostatic hypertrophy may be practically impossible. In a recent case (BUI 22498) on rectal exam-

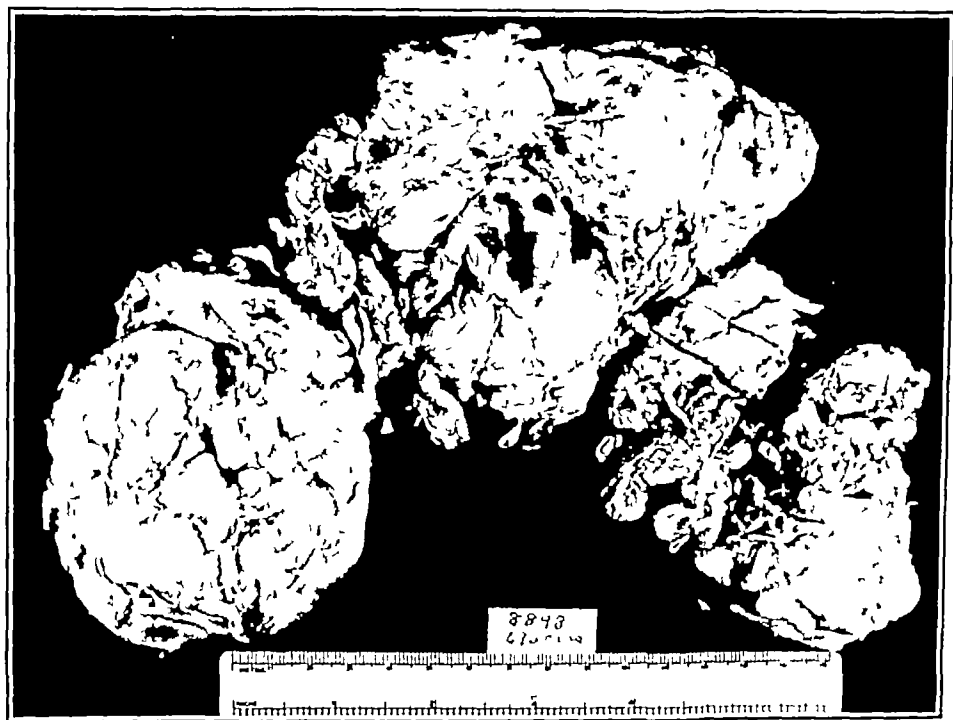


FIG 525 — Photograph of specimen removed at operation. Microscopic diagnosis — sarcoma of the prostate. BUI 22498.

mation a huge, elastic enlargement of the prostate was discovered. Cystoscopy revealed a tremendous intravesical growth of the median and lateral lobes. A diagnosis of benign prostatic hypertrophy was made, and suprapubic enucleation by Dr. Gordon M. Dean was carried out without much difficulty. The specimen (Fig 525) weighed 695 gm, far more than any hypertrophy we have ever enucleated. Microscopic examination of the tissue showed mixed cell sarcoma of the prostate. Deep roentgen-ray therapy was advised, but the patient refused. The patient has been followed 2 years and has recent evidence of recurrence. This is the only case of sarcoma of the prostate in the records of the Brady Urological Institute in which enucleation has been carried out, as in benign enlargements.

As described in the second edition of this book, our first case was that of a man with a huge soft prostate. At perineal operation a pulpaceous mass was encountered, which could be scraped out with the finger. It was found to be a round-cell sarcoma. There were no delimiting capsules and enucleation could not be carried out, nor the operation made complete.

In the third case (BU 13588) operated upon by Dr. Colston, the tumor was retrovesical, distant from the prostate and could not be removed entirely.

In cases in which the sarcoma originates in the adnexa of the prostate, retrovesical tissues in and around the seminal vesicles, vasa deferentia and lateral walls of the bladder, the prostate may not become involved until late and in some cases is not involved at all, yet the condition should be treated as a problem along with those of simple sarcoma originating in the prostate. The symptoms, the pressure upon the rectum, bladder and ureters are quite similar to those beginning in the prostate. In such cases a goodly portion of the prostate may be perfectly normal, the tumor invading only its upper portion and then immediately extending widely in each direction in the form of a great retrovesical mass which is usually smooth and often quite soft. Cases that are irregular and indurated have been reported. The rectum is often so greatly compressed that defecation is almost impossible. The trigone and floor of the bladder are often pushed so far forward as to leave very little bladder capacity. This is well shown by cystoscopy and cystography. The urethral orifice in such cases is generally normal and the posterior urethra not much increased in length. In the case which we have described above there was tremendous increase in the length of the prostatic urethra produced by the immense sarcomatous lobes which extended far out into the bladder. Carcinomata of the prostate are in rare instances extremely soft, sometimes a result of hemorrhage into the tumor, at others necrosis of the malignant cells. In such a case it may be impossible to differentiate from sarcoma. Sarcoma of the prostate may also simulate abscess which however is usually not so extensive, more smooth, more circumscribed and more definitely fluctuant than sarcoma.

The age of the patient is one of the most important diagnostic points to consider. As mentioned above, the great majority of sarcomata occur before the age of prostatic hypertrophy or carcinoma, but here again there are exceptions. In most cases the great mass of the sarcoma lies well above the prostate which may be only slightly involved. The tumor present is really a retrovesical mass, often of great size before the patient applies for treatment. In some cases there is quite a distance between the prostate and the enlargement, as will be seen later on. The diagnosis between sarcoma, carcinoma and hypertrophy really presents very little difficulty in most cases.

Treatment.—In young patients operations have been absolutely unsuccessful. In the adult the results have not been brilliant but several cases in which the patient was relieved for a considerable period

are on record Spanton, in 1882, enucleated through the perineum a very large sarcoma of the prostate, but the patient died on the following day In 1894 Socin removed a tumor the size of two fists through the anus and rectum, without injury of the urethra or bladder The rectum was then sutured The patient showed no evidence of recurrence for three years Verhoogen, in 1898, extirpated the prostate with its capsule and urethra after division of the membranous urethra The patient died later of a recurrence of the sarcoma

Owing to the fact that sarcoma of the prostate generally begins in the upper portion of the posterior part of the gland and rapidly involves the capsule and retrovesical structures, it seems probable that radical measures can never be as successful as in cancer Sarcoma may remain encapsulated, as in Socin's case, and a complete extirpation through the perineum may be possible The suprapubic route will probably not be available, owing to the retrovesical character of the growth Suprapubic drainage may be necessary in some cases

Of the 3 cases, which have been subjected to operation at the Brady Urological Institute, in only 1 was apparently removal of the tumor possible The operation was followed by relief of obstruction for two years when the tumor recurred In the other 2 only a partial extraction was obtainable, and nothing of value accomplished In the 22 cases seen at the Brady Urological Institute, we have found it possible to divide them into four groups

GROUP 1 — *Primary Sarcoma of the Prostate, 3 Cases* — Two of these patients were under forty years of age The symptoms had been present eight months and four years respectively, and both were characterized by marked obstruction, one resulting in great frequency of urination, and the other in complete retention, or catheter life Treatment by means of deep roentgen-ray and radium therapy resulted in a remarkable disappearance of the tumor mass, so that in both cases the prostate was practically normal when the patient was discharged The conditions present on admission are shown in Fig 526 Figs 527 and 528 show the rapidity with which the tumor disappeared One of these patients was followed for three years, and showed no evidence of recurrence In the other case the patient died of metastases

GROUP 2 — *Sarcoma of Both Prostatic and Retrovesical Regions, 11 Cases* — Of these 11 cases, 3 patients were over fifty years of age, 7 between nineteen and forty-one, and 1 only fifteen months old The symptoms had been present under one year in 6 cases, one year, 2, two years, 2, four years, 1 The onset symptoms were pain, 4 cases, difficulty, 6, frequency, 7, hematuria, 0, difficulty of defecation, 1 On examination the tumor mass was found to be large in 3 cases, very large in 7 cases, and apparently confined to the prostate in 1 case In this case it was evident later that a mass of sarcoma had been present beyond the reach of the finger, high up back of the bladder, from which it involved the rectum, eventually filling the pelvis and even invading the retroperitoneal glands Radium was applied to the prostate, which alone was thought to be involved, through the urethra, trigone and

rectum and resulted in a return of the prostate to apparently normal condition. Frequency and difficulty of urination completely disappeared. Realizing the need of deep roentgen-ray therapy, this was ordered for the patient but through a mishap not given. Subsequently

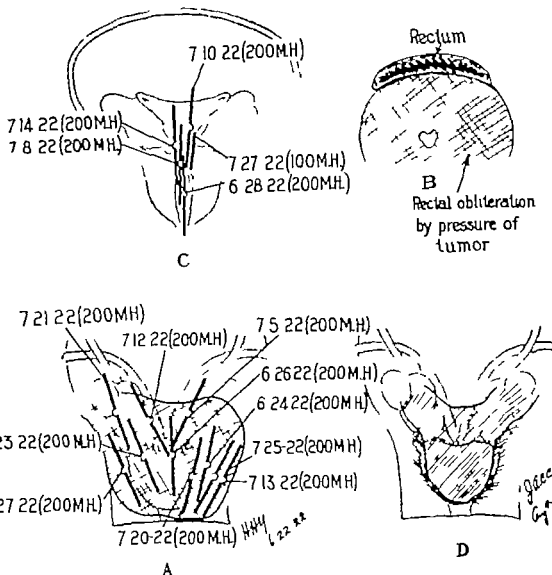


FIG. 50.—Chart of rectal examination in case of sarcoma of the prostate. *A* posterior aspect showing immense tumor involving the entire prostate and the region above. 2000 mg. radium given, as indicated. *B* cross section showing the tumor mass almost obliterating the rectum. *C* radium treatment applied through urethra, 900 mg. BUI 10528.

the retrovesical and peri-rectal mass grew so rapidly that deep roentgen-ray therapy was of no value. This case shows the importance of early diagnosis and very thorough treatment both with radium and deep roentgen ray therapy.

Three of the patients in this group were wearing suprapubic drainage

tubes, and in 3 there was residual urine of 40, 125 and 200 cc respectively. In all cases radium was applied through the rectum, urethra and bladder, and in some instances it was supplemented by deep roentgen-

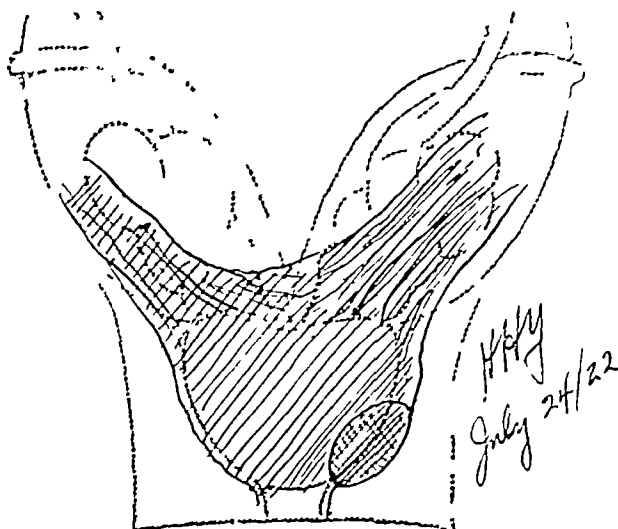


FIG 527 —Rectal chart (same case as Fig 526) one month later after having had 2900 mg radium. Note the great reduction in the tumor. BUI 10598

ray therapy. In 1 case (Fig 529) the patient is still well, now almost eleven years after the beginning of the radium treatment. Although in the other cases there was a remarkable immediate improvement in

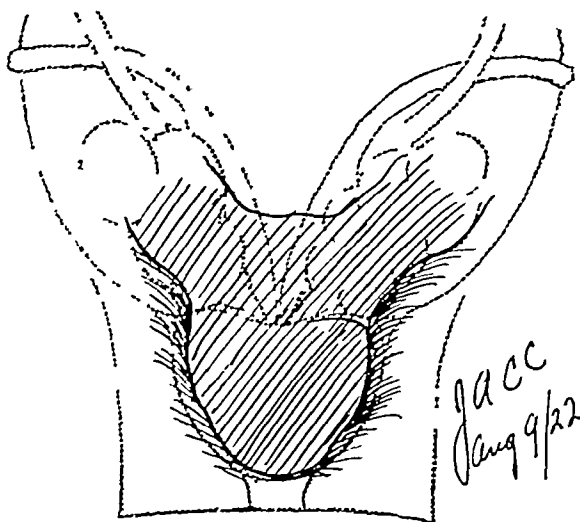


FIG 528 —Rectal chart (same case as Fig 526) made by Dr Colston two weeks later. Note that the prostate has returned to normal in size, and is only slightly indurated. Vesicles also only slightly indurated. BUI 10598

the symptoms, and great regression of the tumor, these patients have ultimately died of sarcoma. If it had been possible in all these cases to have given a complete course of deep roentgen-ray therapy, and to

have followed this up by repetitions of the treatment at sufficiently frequent intervals, it is possible that other patients in this group would have been cured

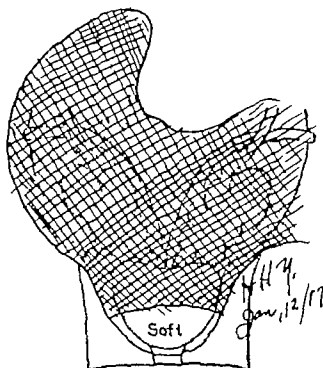


FIG 529 —Chart showing rectal examination. The anterior half of the prostate is soft and almost normal. The tumor invades the upper half of the prostate and occupies the region of the vesicles, bladder and lateral walls of the pelvis. Patient was forty-one years of age and admitted on January 12 1917 complaining of very difficult and frequent urination. He received radium applications per rectum, 100 mg. by urethra, 300 mg. through the trigone 100 mg. Young's rectal radium applicator being used, as described on p 892. Within two months urination had returned to normal and the retrovesical and prostatic mass had completely disappeared. Examination on January 17 1921 showed that the prostate and vesicles were only slightly enlarged and indurated and the patient was entirely free from symptoms and his condition was excellent. On November 3 1927 his physician wrote that the condition was absolutely perfect and that there had been no recurrence. E. G. C., BUI 5084.

GROUP 3 —Five Cases in Which the Sarcoma Did Not Involve the Prostate but Formed a Large Retrovesical Mass Involving the Region of Seminal Vesicles on Both Sides —Ages over fifty years 4 cases four years, 1. Symptoms had been present for one year in 2 cases and less than one year in 3. The onset symptoms were pain 2 cases difficulty of urination, 3 frequency 3 bowel obstruction 3. Examination showed the tumor of considerable size in 1 case very great in 4 a very large retrovesical sarcoma is depicted in Fig 530 induration none slight in 1 rectal obstruction slight 1 very great 2 bladder obstruction slight 2 very great 1 retention complete 1 glands not palpated in any case. Treatment radium 3 cases in all with marked improvement suprapubic drainage 1 no treatment 1. Treatment was ineffectual in all these cases. It is evident that we should have employed deep

roentgen-ray therapy vigorously in all these cases. It is possible that better results might have been obtained.

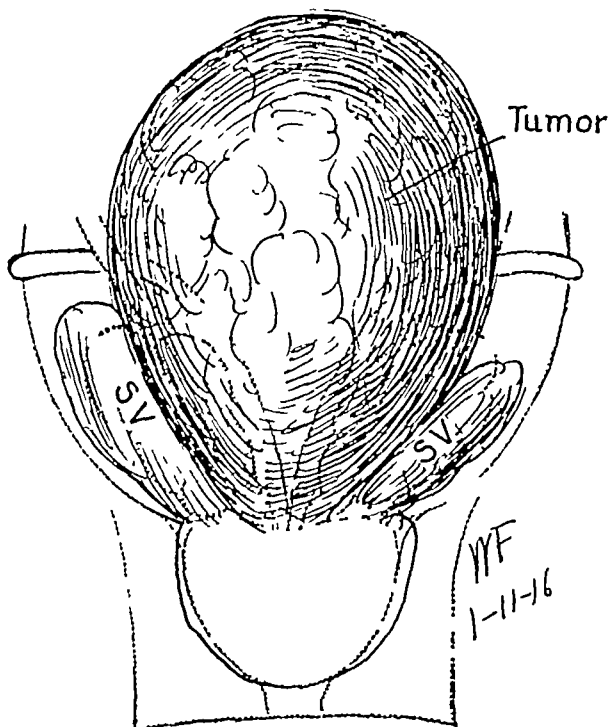


FIG 530 —Chart of rectal examination. Large globular, soft, retrovesical tumor involving only slightly the vesicles and not the prostate. Patient was fifty-one years of age, and admitted on January 8, 1916 with great difficulty of defecation and urination. The duration of symptoms was about six months. Full courses of radium treatments were given without effect. At abdominal operation to relieve intestinal obstruction the bowel was found to be invaded with sarcoma. The condition was improved at time of discharge. No further report. R. L., BUI 4811.

GROUP 4 — *Three Cases in Which the Sarcoma was Neither in the Region of the Prostate or Seminal Vesicles, but Off to One Side, Retrovesical, and Attached to or Fairly Close to the Pelvic Wall* — All these patients were young adults, with symptoms of only three months in 2, and eighteen months in 1. Symptoms: pain, difficulty and frequency of urination, only 1 with rectal obstruction. The tumor was moderately large in 1 and very large in 2. In 2 cases the consistence was very soft, and in the third very hard. In this case (Fig 531) the tumor was attached to the pelvic wall, and was thought it might be an osteosarcoma. Radium and deep roentgen-ray therapy were employed with wonderful effect in this case, and the patient is reported well, now seven and a half years since beginning treatment. One patient has disappeared, the third, which was the smallest of the 3 cases, was subjected to perineal operation with the hope of a radical excision, but it was impossible to remove the deeper portions of the retrovesical tumor. Radium was implanted. Examination two years later showed extensive recurrence. Roentgen-ray was not employed.

Conclusion — Analyzing the 22 cases described in the four groups we find that the tumor was large in 7 cases, very large or huge in 11, apparently small in 1. In 8 cases there was no induration, in 1 it was light in 7 moderate, and in only 1 very hard. There was no rectal compression or occlusion in 12 cases. In the other 10 cases it was slight 2 moderate 3 considerable 4 almost complete 1. Vesical obstruction none 3 light 6 moderate 1 considerable 6 complete 1. Glands found on rectal examination in only 1 case. The tumor did not invade or ulcerate into the mucosa of either the bladder or rectum in any case. Seventeen patients were subjected to radiotherapy by Young's simple applicator fastened by means of a clamp to the

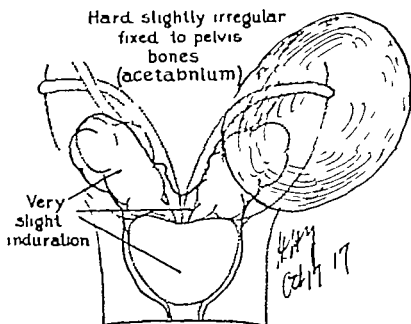


FIG. 311.—Chart of rectal examination. Large, hard, globular tumor attached to pelvis and involving the upper portion of prostate. The patient was twenty-seven years of age and admitted on October 17, 1917, with a history of pain in the lower abdomen for three months. On admission his complaint was difficulty and frequency of urination. Radium and deep roentgen-ray therapy (two series each) resulted in a rapid disappearance of the tumor. Patient reported well at seven and one-half years. R. M., BUI 3434.

table. In a few cases deep roentgen ray therapy was employed as well. The results were negative in 3, marked improvement with practically complete disappearance of the tumor mass in 9, apparent cures in 4. Two of these patients have been followed seven and one-half years and eleven years and are reported well.

Final Conclusion — As we have shown above, sarcoma very rarely involves the prostate alone. On the first examination there is usually a retrovesical mass involving the region of the seminal vesicles and the prostate so that it is impossible to find where the disease originated. The term sarcoma of the prostate has been rather loosely employed. As shown in this series of cases, sarcoma in the prostatic-vesicular

roentgen-ray therapy vigorously in all these cases. It is possible that better results might have been obtained

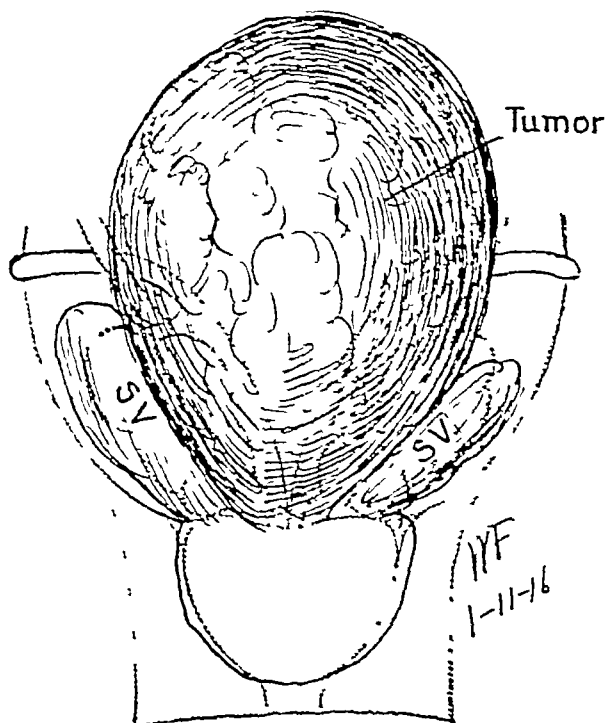
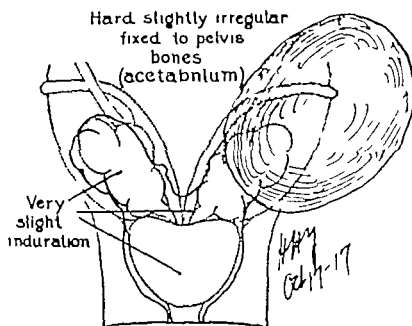


FIG 530 —Chart of rectal examination. Large globular, soft, retrovesical tumor involving only slightly the vesicles and not the prostate. Patient was fifty-one years of age, and admitted on January 8, 1916 with great difficulty of defecation and urination. The duration of symptoms was about six months. Full courses of radium treatments were given without effect. At abdominal operation to relieve intestinal obstruction the bowel was found to be invaded with sarcoma. The condition was improved at time of discharge. No further report. R. L., BUI 4811

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Conclusion — Analyzing the 22 cases described in the four groups we find that the tumor was large in 7 cases very large or huge in 11 apparently small in 1. In 8 cases there was no induration in 4 it was slight in 7 moderate and in only 1 very hard. There was no rectal compression or occlusion in 12 cases. In the other 10 cases it was slight 2 moderate 3 considerable 4 almost complete 1. Vesical obstruction, none 3 slight 6 moderate 3 considerable 6 complete 1. Glands found on rectal examination in only 1 case. The tumor did not invade or ulcerate into the mucosa of either the bladder or rectum in any case. Seventeen patients were subjected to radiotherapy by Young's simple applicator fastened by means of a clamp to the



111-331 — Chart of rectal examination. Large hard globular tumor attached to pelvis and involving the upper portion of vesicle. The patient was twenty-seven years of age and admitted on October 17 1917 with a history of pain in the lower abdomen for three months. On admission his complaint was difficulty and frequency of urination. Radium and deep roentgen-ray therapy (two series each) resulted in a rapid disappearance of the tumor. Patient reported well now seven and one-half years. R. M., BUI 54-1

table. In a few cases deep roentgen ray therapy was employed as well. The results were negative in 5 marked improvement with practically complete disappearance of the tumor mass in 9 apparent cures in 4. Two of these patients have been followed seven and one-half years and eleven years and are reported well.

Final Conclusions — As we have shown above sarcoma very rarely involves the prostate alone. On the first examination there is usually a retrovesical mass involving the region of the seminal vesicles and the prostate so that it is impossible to find where the disease originated. The term sarcoma of the prostate has been rather loosely employed. As shown in this series of cases sarcoma in the prostatico-vesicular

region can be appropriately divided into four groups 1, those originating in and involving the prostate, but not the vesicles, 2, those involving both prostate and vesicles, origin not certain, 3, those originating in the region of the vesicles, and not involving the prostate These form the majority and usually become huge retrovesical tumors These represent the class sometimes called retro-vesical sarcomas, 4, tumors adjacent to the vesicle and behind the bladder, but possibly springing from the pelvic wall One-half of these tumors appear in men under thirty-six years of age They are characterized by a very rapid growth, increased frequency and difficulty of miction, and gradual development of obstruction to the bowel In the majority of cases, they are remarkably sensitive to radiotherapy The mass disappears more or less completely as a result of radium applications through the rectum, urethra and bladder Deep roentgen-ray therapy should be employed In many of our cases this proved to be impossible Had it been done, I believe the number of cures would have been far greater Even so, 3 apparent cures, 1 over seven and one-half years, and another over eleven years are recorded The first case of sarcoma to be cured by radium treatments was apparently that reported in this chapter of Cabot's "Modern Urology" in 1918 This patient was reported by his physician to be well almost eleven years after the radium treatment was given

The prognosis in sarcoma of the prostate and its adnexa in the retro-vesical regions therefore is not hopeless, and a considerable number of cures should be obtained by intensive radium and deep roentgen-ray therapy

In general it would seem probable that operative intervention in cases of sarcoma of the prostate which are extensive enough to be diagnosed clinically should be limited to the relief of obstruction or to the treatment of complications, such as abscess formation

CHAPTER XXI

PROSTATIC CALCULI

BY HUGH HAMPTON YOUNG M.D. F.A.C.S. HON. F.R.C.S.I.

It is now the custom to classify prostatic calculi as endogenous, and exogenous. Endogenous calculi are those which form within the substance of the prostate. They are the most interesting because of the difficulty experienced in explaining their origin, location, relationship to other prostatic pathology, prostatitis, hypertrophy, carcinoma, etc. The exogenous calculi are those found in the prostatic urethra, either having developed there in pockets (diverticula, etc.) or having reached the prostatic urethra from the kidney, ureter or bladder.

We have recently made an exhaustive study of 100 cases of calculi of the prostate found in the records of the Brady Urological Institute. The coexistent pathology in these cases is given in the following tabulation (Table 1).

TABLE 1—COEXISTENT PATHOLOGY IN 100 CASES OF PROSTATIC CALCULI

	Cases.
Calculi with benign adenomata of the prostate	29
Calculi with prostatitis, chronic	50
Calculi with prostatitis and carcinoma	3
Calculi following prostatic abscess	6
Calculi in prostatic fossa, following prostatectomy	5
Calculi in prostate without clinical evidence of prostatitis	7
Calculi in utricle	1

The *age* at which prostatic calculi of all types were noted is: twenty to twenty-nine years, 3; thirty to thirty-nine years, 8; forty to forty-nine years, 10; fifty to fifty-nine years, 31; sixty to sixty-nine years, 24; seventy to seventy-nine years, 14; eighty to eighty-nine years, 1.

A further analysis of cases in which perineal prostatolithotomy was done shows that the *age of those not associated with prostatic hypertrophy* is: thirty to thirty-nine years, 1; forty to forty-nine years, 4; fifty to fifty-nine years, 5; sixty to sixty-nine years, 10; seventy to seventy-nine years, 2; total 22 cases. There were 45 cases in which no operation was performed. Many of these were of prostatitis and not adenomata.

The *age of those in which prostatic hypertrophy was present* was: fifty to fifty-nine years, 6; sixty to sixty-nine years, 8; seventy to seventy-nine years, 8; eighty to eighty-nine years, 1; total 23 cases.

PROSTATIC CALCULI OF ENDOGENOUS TYPE.

In 95 of our cases the calculi were found within the substance of the prostate. As will be seen in Table 2, one-half the cases were associated with chronic prostatitis, and 29 per cent with benign adenoma of the prostate.

Pathology—Endogenous calculi may form within the substance of the prostatic gland, with or without prostatitis. They vary in size and number, as shown in Fig 532. The presence of calculi leads to inflammatory changes in the prostatic tissue, as shown in Figs 533 and 534. The calculi had to be removed, before the sections could be cut, but the acini and spaces from which the calculi were removed are plainly seen, and the pathological conditions present are described in the legends.

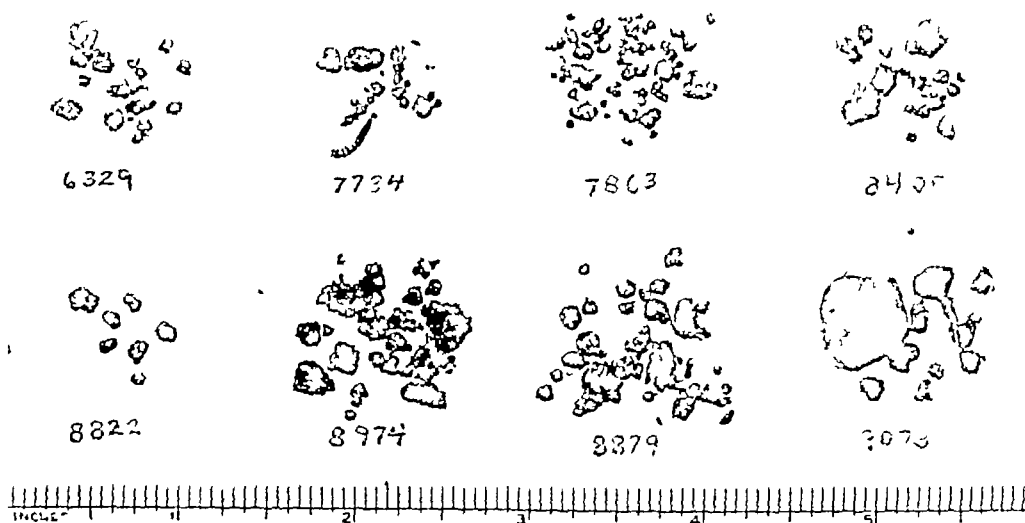


FIG 532 *—Photograph, natural size, of calculi removed from 8 B U I cases, pathological numbers of which appear below specimens. Careful chemical analysis of the calculi in these groups shows calcium oxylate and phosphate. A section of the largest calculus shows concentric layers very similar to those seen in urinary calculi, in this instance calcium phosphate. There was no central soft area suggesting organic nucleus, nor was it possible, by chemical methods, to determine the presence of amyloid in any of the calculi.

Group 1. Cases of Prostatic Calculi Associated with Prostatitis —

Etiology—A history of gonorrhea was noted in 36 cases (54 per cent). In these prostatic symptoms developed soon after the gonorrheal infection, and often continued for many years. It was generally impossible to differentiate between the symptoms produced by prostatitis, and those by calculi. In one patient seen by me, suffering from acute retention, due to a gonorrheal prostatitis many years previously, the urine was removed by suprapubic aspiration six times before he began to void. He recently returned, and a large calculus could be felt in the prostate (Fig 535). For many years he had been treated by various physicians for chronic prostatitis, massage having been carried out upon a prostate full of stones, and sounds passed for a supposed stricture of the prostatic urethra with excruciating pain.

It is not always possible to determine whether the prostatitis pre-

* Figs 532 to 542 and Figs 545 and 546 reprinted from *Journal of Urology*, December, 1934, courtesy of Williams & Wilkins Company.

ceeds the development of the calculi. In rare instances endogenous calculi work their way into the urethra and are passed with the urine. Various authors have ascribed to corpora amylacea a causative influ-



FIG. 533



FIG. 534

FIG. 533.—reaction showing four acini each surrounded by marked inflammatory infiltration. In the upper field 2 stones were found. The section in this case was taken from the posterior lamella or lobe there being adenomatous lateral lobes, which showed no infection and no stones. The stones were removed before sectioning tissue. B. U. I. 20408.

FIG. 534.—Chronic prostatitis with calculi. Below are seen two acini surrounded by marked inflammatory infiltration. In the upper part of the field large acini, each containing a calculus, are surrounded by much inflammation. The stones were removed before sectioning tissue. B. U. I. 20408.



FIG. 535



FIG. 536

FIG. 535.—Prostatic calculi in patient aged fifty-seven years, who had gonorrheal proctitis at age of nineteen years. Subsequent development of strictures, bands passed innumerable times. Prostatic masses for years (shown here). Calculi probably present all this time removed in 1934 through perineum with relief of strictures, sepsis, toxic psychosis, etc. B. U. I. 1380.

FIG. 536.—Multiple prostatic calculi (large) in patient aged forty three years. History of gonorrhea, difficulty and frequency of urination for eighteen months. Perineal removal of calculi. B. U. I. 20331.

ence in the development of endogenous prostatic calculi. According to Thompson, corpora amylacea, having attained the size of their inclosing follicle, act as foreign bodies, and in consequence of the general law that all mucous membranes, when sufficiently irritated, throw out a deposit of calcium phosphate and carbonate, ultimately form calculi. The amount of earthy matter varies from 45 to 85 per cent. The number of calculi present may vary from one to several hundred. They are generally a little less than that of a barley-seed in diameter, but they may range in size from 2 mm. to 3 to 4 cm.

In one case in which the patient had had gonorrhea fifteen years before, there were no symptoms until about eighteen months before admission. Catheterization was then required. Fig 536 shows the very large mass of stones that were present in the lateral and median portions of the prostate. They must have been there much longer than the eighteen months. After perineal removal, in which no hypertrophy was discovered, the patient was discharged as cured.

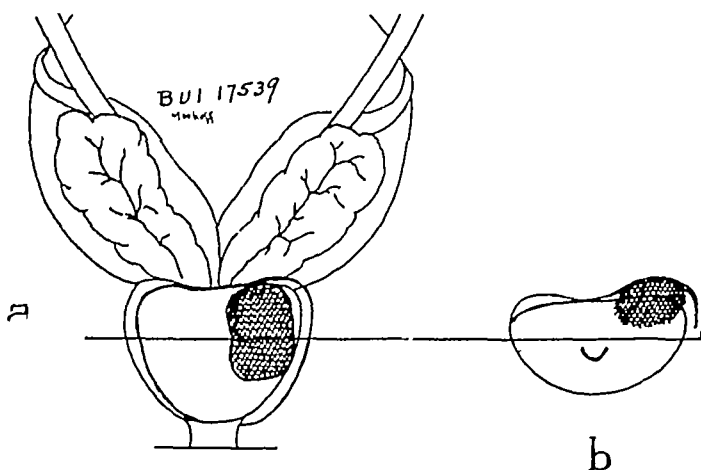


FIG 537 —Rectal chart showing large area of calculi in right lobe of prostate in patient, aged forty-six years, with history of gonorrhea twenty-one years previously, and nocturia every two hours. Calculi not detected by cystoscope. Removal of calculi by perineal prostatectomy. Removal of small bar, but not lateral lobes. Cure. BUI 17539.

In one case an isolated hard area, palpable in the right lobe of the prostate, was present (Fig 537). It was apparently of third degree induration, and a diagnosis of carcinoma was considered until a roentgen-ray was obtained, which showed calculi in the prostate, much more extensively distributed than was made out on rectal examination (Fig 538).

Symptoms —As a rule prostatic calculi of the endogenous type, associated only with prostatitis, cause but slight disturbance, and the gland may be filled with calculi, and yet no marked symptoms occur. On the other hand, symptoms of irritation, pain (local and referred), various sexual and urinary symptoms, as will be seen in Table 2, may develop. As shown in this tabulation, in about 50 per cent of these

cases gonorrhea was present. It is noteworthy that sexual symptoms were present in only about 21 per cent of the cases although the calculi were often in and around the ejaculatory ducts and sometimes the seminal vesicles. Urinary symptoms were far more common especially frequency and dysuria and even complete retention. The rarity of hematuria indicates the infrequency with which these calculi project



FIG. 338.—Same case as Fig. 339. Roentgen-ray showing extensive calcification within prostate. Both lobes involved. Calculi of left lobe not detected upon rectal examination (Fig. 339). Calcified gland higher up in pelvis. BUI 17519.

TABLE 2.—ANALYSIS OF HISTORIES IN 96 CASES OF ENDOGENOUS PROSTATIC CALCULI.

	Prostatic glands with benign adenomata (29 cases)		Prostatic glands with benign adenomata (67 cases)	
	Cases	Per cent.	Per cent.	Cases
Average age	64			53
Gonorrhea	13	45	54	30
Sexual	Premature ejaculation	0	0	4
	Painful ejaculation	0	0	7
	Impotence	2	7	3
Frequency	9	31	60	40
Urgency	5	17	10	7
Difficulty	8	28	9	6
Dysuria	10	34	36	21
Hesitancy	5	17	4	3
Dribbling	5	17	12	8
Retention	5	17	18	12
Incontinence	0	0	1	1
Hematuria	5	17	0	4
Prostatic abscess	0	0	5	5
Pain	Lumbar	5	17	4
	Perineal	0	0	2
	Rectal	0	0	1
	Deep urethral	4	14	1
Groin	0	0	3	2
Asymptomatic	0	0	9	6
Findings	Stricture	5	17	13
	Calculi	2	7	4
	Kidney and ureteral Vesical	3	10	3

Four cases of exogenous prostatic calculi are not included in this tabulation.

ence in the development of endogenous prostatic calculi. According to Thompson, corpora amylacea, having attained the size of their inclosing follicle, act as foreign bodies, and in consequence of the general law that all mucous membranes, when sufficiently irritated, throw out a deposit of calcium phosphate and carbonate, ultimately form calculi. The amount of earthy matter varies from 45 to 85 per cent. The number of calculi present may vary from one to several hundred. They are generally a little less than that of a barley-seed in diameter, but they may range in size from 2 mm. to 3 to 4 cm.

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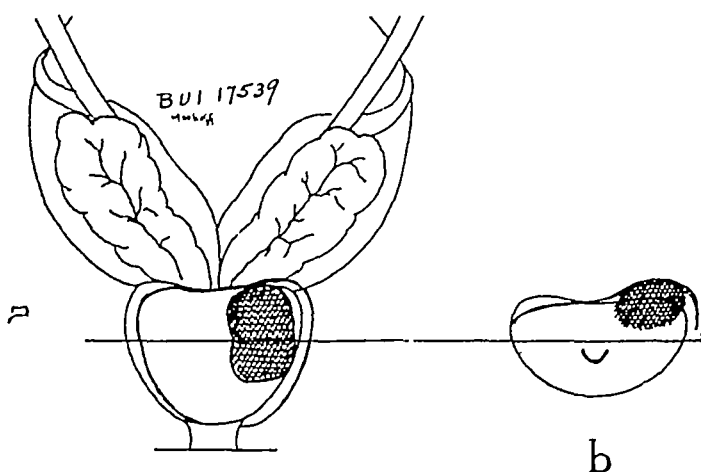


FIG 537 —Rectal chart showing large area of calculi in right lobe of prostate in patient, aged forty-six years, with history of gonorrhea twenty-one years previously, and nocturia every two hours. Calculi not detected by cystoscope. Removal of calculi by perineal prostatectomy. Removal of small bar, but not lateral lobes. Cure. BUI 17539

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Symptoms —As a rule prostatic calculi of the endogenous type, associated only with prostatitis, cause but slight disturbance, and the gland may be filled with calculi, and yet no marked symptoms occur. On the other hand, symptoms of irritation, pain (local and referred), various sexual and urinary symptoms, as will be seen in Table 2, may develop. As shown in this tabulation, in about 50 per cent of these

cases gonorrhea was present. It is noteworthy that sexual symptoms were present in only about 21 per cent of the cases although the calculi were often in and around the ejaculatory ducts and sometimes the seminal vesicles. Urinary symptoms were far more common especially frequency and dysuria, and even complete retention. The rarity of hematuria indicates the infrequency with which these calculi project



FIG. 328.—Same case as Fig. 329. Roentgen-ray showing extensive calcification within prostate. Both lobes involved. Calculi of left side not detected upon rectal examination (Fig. 329). Calcified gland higher up in pelvis. B U I 1530.

TABLE 2.—ANALYSIS OF HISTORIES IN 96 CASES OF ENDOGENOUS PROSTATIC CALCULI

	Prostatic calculi with benign adenomata (79 cases)		Prostatic calculi without benign adenomata (67 cases)	
	Cases	Per cent	Per cent	Cases
Average age	64			53
Gonorrhea	13	43	54	30
Sexual	Premature ejaculation	0	0	4
	Painful ejaculation	0	10.4	7
	Impotence	3	4.5	3
Frequency	27	93	60	40
Urgency	5	17	10.4	7
Difficulty	8	28	0	0
Dysuria	10	34	36	24
Hesitancy	5	17	4.5	3
Dribbling	5	17	12	8
Retention	5	17	16	12
Incontinence	0	0	1.5	1
Hematuria	5	17	0	4
Prostatic abscess	0	0	7.5	5
Pain	Lumbar	5	17	4
	Perineal	0	0	3
	Rectal	0	0	1.5
	Deep urethral	4	14	1.5
	Groin	0	0	2
Asymptomatic	0	0	9	6
Findings	Stricture	5	17	13.4
	Calculi	2	7	22.4
	Kidney and ureteral vesical	3	10.3	4.5

* Four cases of exogenous prostatic calculi are not included in this tabulation.

into the urethra. Pain is remarkable by its comparative rarity, and it is noteworthy that 9 per cent of the cases are without symptoms. In most of these cases the diagnosis of chronic prostatitis had been made, and generally the patient had been subjected to many months, or even years, of local treatment—massage, irrigations, injections, sounds, etc. The fact that skilful practitioners had failed to recognize the presence of calculi on numerous rectal examinations indicates how important it is to take a roentgen-ray in all these cases.

Diagnosis—In only a small proportion of our cases was the presence of a calculus made out on rectal examination. This was especially true when the calculi were isolated or few. In some cases, in which the calculi could not be felt, crepitus was made out. In some instances the calculi could be easily felt. In most cases the positive diagnosis was made by the roentgen-ray.

Roentgen-ray Technique in Cases of Prostatic Calculi—We have elsewhere described a special technique advantageous in obtaining a proper demonstration of calculi within the prostate. With the ordinary roentgen-ray picture, taken with the tube, immediately in front of the mid-part of the abdomen, the prostatic shadow lies immediately behind the symphysis pubis, and the calculi may be difficult to see, or even be obscured. The exposure should be made with the rays directed down the pelvic strait. This can be obtained by removing the thighs from the knee crutches, dropping the feet so that the thighs are in line with the body, and arching up the back upon a pillow beneath the dorsal vertebra. The pelvis is tilted so that the tube can be easily placed so that the rays are directed down the pelvic strait. A film is thus obtained, in which the prostatic shadow is entirely within the pelvic shadow, and the calculi easily discovered (Fig. 538).

In only a few cases was much assistance in diagnosis obtained by means of cystoscopy or urethroscopy, except in excluding vesical calculi. The urethra was usually intact, and showed little more than hyperemia or chronic infection. In 2 cases calculi had eroded through the mucous membrane, and in 2 a calculus was seen in the small hole in the floor of the urethra. As stated above, the diagnosis is usually made by the roentgen-ray, and in many cases, even when the presence of calculi in great number were shown in the film, it was impossible to feel them, or obtain a crepitus on rectal examination.

Treatment—The treatment of endogenous calculi, not associated with hypertrophy or carcinoma, has varied greatly. If the symptoms are negligible, the prostatic secretion and urine sterile, sexual powers normal, we usually do not advise operative treatment, even though many calculi may be shown by the roentgen-ray. In such cases, we usually desist from giving prostatic massage or other forms of local treatment. Many of these patients are quite comfortable, although their prostates are filled with small calculi.

In other cases, with local symptoms such as, burning, irritation, pain, hematuria, difficulty, frequency, marked obstructive symptoms, back pressure effects—we have urged operative removal. In 2 cases a few

stones were removed by endoscopy with forceps and swabs. In 1 case in which there was present a contracture of the vesical neck with obstruction to urination a punch operation was followed by evacuation of the calculi. Such methods or the more extensive transurethral resection certainly cannot be recommended because the removal of the calculi would undoubtedly be very incomplete in most cases although cases thus operated have been reported. I prefer to carry out perineal prostatic lithotomy. The ideal operation in such cases is to remove the calculi without opening the urinary tract (Fig 539)

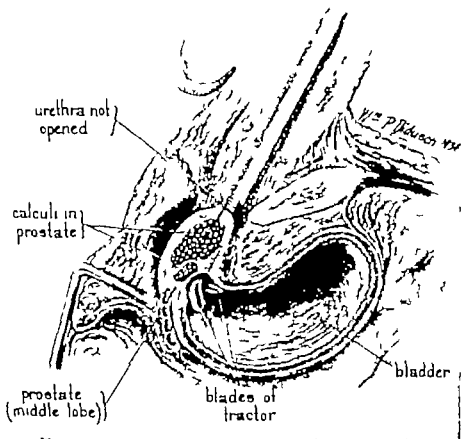


FIG 539 — Young's long urethral tractor used to expose prostate filled with calculi, which may thus be removed without opening urethra.

Perineal Prostatic Lithotomy — A long prostatic tractor is passed until the beak reaches the prostatic urethra. The usual inverted U incision is made the central tendon isolated and divided the rectourethralis muscle picked up and incised near the membranous urethra the posterior layer of Denonvilliers fascia pushed backward after division of its fibers near the apex of the prostate. The long tractor is then pushed into the bladder opened out, and the prostate forced into the perineal wound by traction and leverage (Fig 540 No 1). Having exposed and palpated the posterior surface of the prostate an incision is made on each side of the median line about 1.5 cm

apart The scalpel passes through capsule and posterior lamella of the prostatic tissue, in front of which calculi are usually encountered, in small cavities, sometimes single, but often multiple In some cases the entire lateral lobe is filled with great numbers of calculi In other cases they are embedded in the tissues, so that an excision of each lateral lobe is required to completely remove them After removing the calculi from the lateral lobes, a careful examination of the suburethral portion of the prostate should be made, as frequently calculi are found

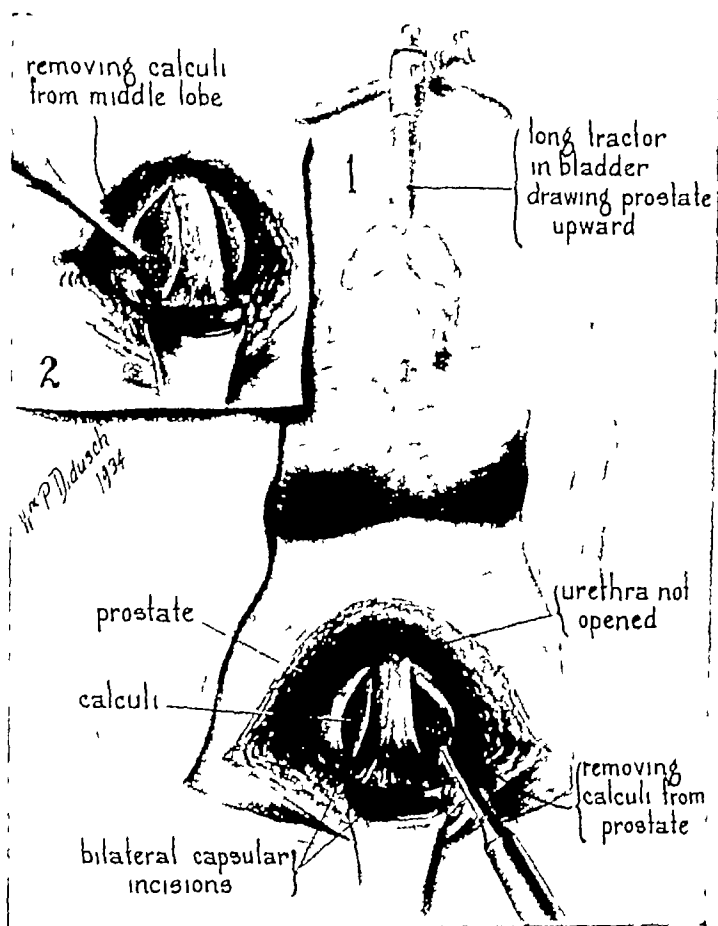


FIG 540—1, Removal of calculi from lateral lobes of prostate with long tractor, 2, removal of calculi from median portion of prostate with curette without opening urethra

in the prespermatic or subcervical portion of the prostate By means of a curette (Fig 540, No 2) their removal is usually completed without difficulty The operator should be careful to determine whether calculi are present in or between the seminal vesicles and ampullæ, and that the outlying portions of the prostate have been completely evacuated In most cases it will have been possible to carry out the operation, above described, without opening into the urethra or bladder In such cases no drainage is usually required, except small gauze packs into each of the lateral cavities Where the urethra is opened, a

catheter inserted through the meatus to drain the bladder may be desirable. The levators are approximated as usual with plain catgut, the wound closed in front and on the left side with interrupted sutures of fine silk, and with the gauze emerging from the right angle of the wound.

The *convalescence* in these cases is usually rapid and free from complications. The gauze is removed on the day after the operation. The indwelling urethral catheter is removed in about a week.

In some cases it is necessary to remove a calculus which may project into the urethra before a tractor can be introduced. In such perineal urethrotomy and introduction of the tractor through it into the bladder is usually the method of choice. Occasionally abscess within or outside the prostate complicates the picture, and may require special treatment. One must guard against generalization of the sepsis. We usually swab out or irrigate thoroughly with 2 per cent mercurochrome and pack the wound. In cases associated with contracture of the vesical orifice, or small bars in the median portion a punch operation in addition to the prostaticolithotomy may be necessary to obtain a good result.

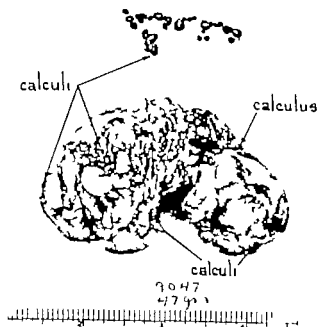


FIG. 541.—Markedly enlarged adenomatous lateral and median lobes enucleated in one piece. Calculi seen embedded in fibrous capsule, none in interior of lobes. B.U.I. 23107

Group 2 Cases of Prostatic Calculi Associated with Prostatic Hypertrophy—In 23 cases adenomatous enlargement of the prostate was present among our 100 patients with prostatic calculi as will be seen in the tabulation (Table 3). As pointed out by us many years ago in such cases the calculi are almost invariably found outside the hypertrophied lobes. They generally lie in the layers of fibrous tissues

apart The scalpel passes through capsule and posterior lamella of the prostatic tissue, in front of which calculi are usually encountered, in small cavities, sometimes single, but often multiple In some cases the entire lateral lobe is filled with great numbers of calculi In other cases they are embedded in the tissues, so that an excision of each lateral lobe is required to completely remove them After removing the calculi from the lateral lobes, a careful examination of the suburethral portion of the prostate should be made, as frequently calculi are found

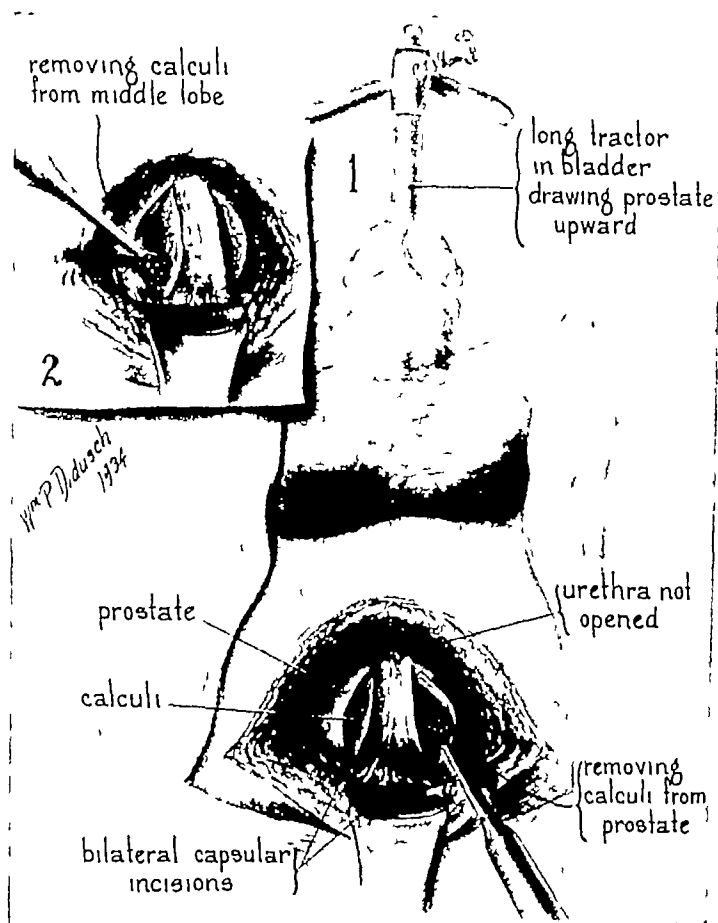


FIG 540 —1, Removal of calculi from lateral lobes of prostate with long tractor, 2, removal of calculi from median portion of prostate with curette without opening urethra

in the prespermatic or subcervical portion of the prostate By means of a curette (Fig 540, No 2) their removal is usually completed without difficulty The operator should be careful to determine whether calculi are present in or between the seminal vesicles and ampullæ, and that the outlying portions of the prostate have been completely evacuated In most cases it will have been possible to carry out the operation, above described, without opening into the urethra or bladder In such cases no drainage is usually required, except small gauze packs into each of the lateral cavities Where the urethra is opened, a

catheter inserted through the meatus to drain the bladder may be desirable. The levators are approximated as usual with plain catgut, the wound closed in front and on the left side with interrupted sutures of fine silk, and with the gauze emerging from the right angle of the wound.

The *convalescence* in these cases is usually rapid and free from complications. The gauze is removed on the day after the operation. The indwelling urethral catheter is removed in about a week.

In some cases it is necessary to remove a calculus which may project into the urethra before a tractor can be introduced. In such perineal urethrotomy and introduction of the tractor through it into the bladder is usually the method of choice. Occasionally abscess within or outside the prostate complicates the picture and may require special treatment. One must guard against generalization of the sepsis. We usually swab out or irrigate thoroughly with 2 per cent mercurochrome and pack the wound. In cases associated with contracture of the vesical orifice or small bars in the median portion a punch operation in addition to the prostatic lithotomy may be necessary to obtain a good result.

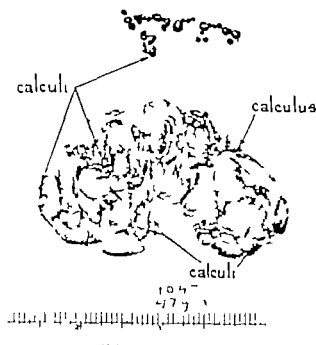


FIG. 311.—Markedly enlarged adenomatous lateral and median lobes enucleated in one piece. Calculi seen embedded in fibrous capsule none in interior of lobes. B.U.I. 23107

Group 2. Cases of Prostatic Calculi Associated with Prostatic Hypertrophy—In 23 cases adenomatous enlargement of the prostate was present among our 100 patients with prostatic calculi as will be seen in the tabulation (Table 3). As pointed out by us many years ago in such cases the calculi are almost invariably found outside the hypertrophied lobes. They generally lie in the layers of fibrous tissues

which form the encapsulation of the adenomatous lobes, and separate them from the non-hypertrophied prostatic tissue which is around them. In Fig 541, calculi may be seen within the thin fibrous capsule of the enucleated lobes. Others were found just outside this layer. In Fig 542 may be seen a cross section of one of the lateral lobes, showing that the calculi are along the periphery of the prostate, and not within

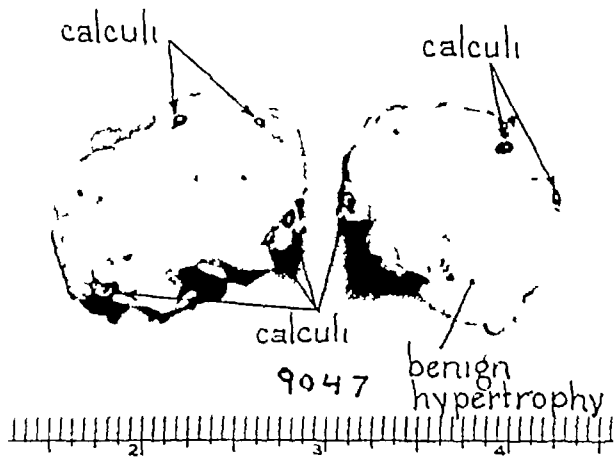


FIG 542 —Same case as Fig 541. Cross-section of two lateral lobes of adenomatous hypertrophy of prostate removed through perineum. The adenomata are free of calculi, but three may be seen in ducts leading to posterior lamella on urethral side of hypertrophy. Several may also be seen in acini of lateral and posterior lamellae. They occur along line of cleavage in acini surrounded by fibrous stroma, but not in the hypertrophy. B U I 23107

the central portions. It seems probable that calculi occur here within prostatic acini or ducts, which are compressed by the growing adenoma, that they do not, therefore, occur in the adenoma itself, but in normal prostatic tissue, in which the glands and ducts are greatly compressed. They are readily seen in perineal prostatectomy, but rarely removed in suprapubic operations.

TABLE 3 —100 CASES OF PROSTATIC CALCULI. RECORD OF OPERATIONS.

Age	No Operation	Perineal prostatic lithotomy		Suprapubic prostatic lithotomy	Endoscopic or cystoscopic removal of prostatic calculi from the prostatic fossa	Total
		Adenomata	No Adenomata			
20-29	1			2		3
30-39	7		1			8
40-49	12		1	2	1	19
50-59	17	6	5		3	31
60-69	6	8	10			24
70-79	3	8	2		1	14
80-89		1				1
Total	16	23	22	4	5	100

Table 3 gives the age, the type of operation used in the 100 cases of prostatic calculi seen at the Brady Institute. On rectal examination in cases with hypertrophy, the calculi may sometimes be felt, but more

frequently the posterior layer of normal prostatic tissue and elasticity of the hypertrophied lobes beyond makes recognition of the calculi by rectal palpation difficult or impossible. On this account a roentgen ray is a valuable addition in the study of cases of prostatic hypertrophy especially if an area of induration suggests carcinoma.

Symptoms.—As stated in Table 2 there are 29 cases of prostatic calculi in our series in which there was benign adenoma present. Conorrhea had been present in 13 cases (45 per cent). Frequency of urination was the most important symptom (93 per cent) with urgency, difficulty, dysuria and hesitancy, dribbling and retention occurring in from 17 to 34 per cent of the cases. Hematuria occurred in 17 per cent. This is distinctly higher than is usually seen in simple cases of benign hypertrophy. Deep urethral pain was present in 14 per cent, pain in the back in 17 per cent, which is also greater than usual. The discovery of an apparent stricture (17 per cent) was probably due to the pressure of the calculi upon the urethra. The presence of calculi in the kidney, ureter or bladder in 17 per cent of the cases is also an important finding. As a rule, unless calculi are large or very abundant the symptoms are not different from those of simple hypertrophy.

Diagnosis.—This is usually impossible except with the roentgen ray, owing to the fact that the calculi are usually found well beneath the posterior lamella of prostatic tissue (posterior lobe). Where they are larger they may be palpated and suggest carcinoma. In such cases a roentgen-ray should always be taken to assist in the diagnosis. Occasionally crepitus can be made out where numerous calculi impinge upon each other. Although calculi are often unrecognized until operation, their rather frequent presence offers another argument for perineal prostatectomy at which they are seen and removed generally before or with the lateral and median lobes.

Treatment.—Unless the hypertrophied lobes produce discomfort or obstructive symptoms, no operation or other treatment may be indicated, but in the great majority of instances patients come on account of difficulty and frequency of urination and operation is indicated.

Perineal Prostate-lithotomy with Enucleation of Hypertrophied Lobes—As stated before, after the prostate has been exposed through the perineum, the calculi are generally encountered at once immediately beneath the posterior lamella or layer of compressed prostatic tissue which is always found back of the hypertrophied lobes. For years we have employed bilateral capsular incisions (Fig. 543). After removal of all the calculi which can be immediately reached the lateral lobes are enucleated. In so doing calculi are often found within the encapsulating normal tissue and removed with the curette or finger. In some cases calculi are found attached to the prostatic lobes (Fig. 541). Rarely they are buried in the normal tissue, and should be carefully searched for with finger and curette. When the median lobe is attacked generally through one of the lateral cavities, calculi may be found posterior to it (Fig. 544). A careful survey of the urethra should also be made to be certain that no stones, projecting into the lumen

which form the encapsulation of the adenomatous lobes, and separate them from the non-hypertrophied prostatic tissue which is around them. In Fig 541, calculi may be seen within the thin fibrous capsule of the enucleated lobes. Others were found just outside this layer. In Fig 542 may be seen a cross section of one of the lateral lobes, showing that the calculi are along the periphery of the prostate, and not within

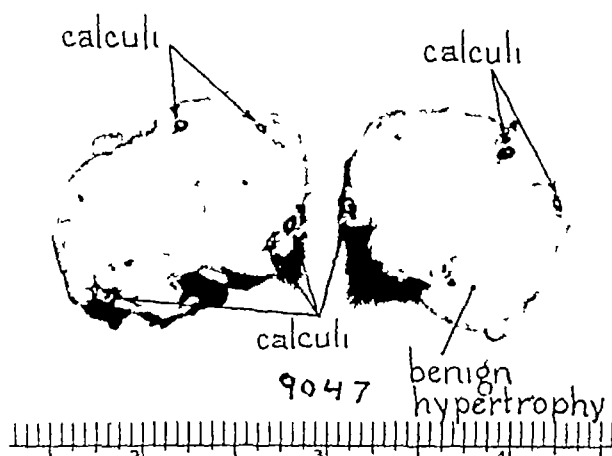


FIG 542 —Same case as Fig 541. Cross-section of two lateral lobes of adenomatous hypertrophy of prostate removed through perineum. The adenomata are free of calculi, but three may be seen in ducts leading to posterior lamella on urethral side of hypertrophy. Several may also be seen in acini of lateral and posterior lamella. They occur along line of cleavage in acini surrounded by fibrous stroma, but not in the hypertrophy. B U I 23107

the central portions. It seems probable that calculi occur here within prostatic acini or ducts, which are compressed by the growing adenoma, that they do not, therefore, occur in the adenoma itself, but in normal prostatic tissue, in which the glands and ducts are greatly compressed. They are readily seen in perineal prostatectomy, but rarely removed in suprapubic operations.

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50-59	17	6	5		3	31
60-69	6	8	10			24
70-79	3	8	2		1	14
80-89		1				1
Total	46	23	22	4	5	100

Table 3 gives the age, the type of operation used in the 100 cases of prostatic calculi seen at the Brady Institute. On *rectal examination* in cases with hypertrophy, the calculi may sometimes be felt, but more

calculi, in order to prevent later formation of calculi in the bladder was also illustrated in this case. The punch may be needed to remove a fibrous bar or contracture of the vesical neck.

Group 3 Cases of Prostatic Calculi Occurring with Carcinoma or Strongly Simulating It.—In our series of 100 cases there have been a good number in which an indurated area so strongly simulated carcinoma that a roentgen ray was not taken. As indicated above such is distinctly an error and all such cases should be studied by the roentgen ray, with the films taken by the proper technique as described above. In some such cases, after exposing the prostate the smooth markedly indurated area was found to be a sac full of tightly packed calculi. In some cases of carcinoma of the prostate calculi were discovered embedded in the tissues of the prostate after the radical operation had been carried out. One such case is shown in Fig 545.

In closing this discussion of the differential diagnosis of prostatic calculi from carcinoma it seems important to stress again the tremendous value of the perineal route through which the prostate can be exposed carefully examined by palpation, incision made into the suspicious areas, a section removed for diagnosis and frozen stained sections prepared if necessary. It is only by this technique that carcinoma can be recognized early the radical operation carried out to effect a permanent cure, which our statistics show has been obtained in over 50 per cent of the cases in which the radical operation was carried out.

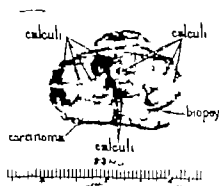


FIG. 545.—Cross-section of prostate removed by Young's radical perineal prostatectomy for carcinoma. Carcinoma limited to posterior lamella. Calculi may be seen in several prostatic ducts near urethra. Several are in lateral lamellae outside small lobules of hypertrophy. B U I 21868.

Group 4. Cases of Calculi in Both the Prostate and Urinary Tract—As shown in Table 2 kidney or ureteral calculi were present in 17 cases, and vesical calculi in 6 cases which were also characterized by prostatic calculi. Certain authors have asserted that in patients with prostatic calculi, a tendency to the formation of calculi in other organs had been detected. Our statistics hardly bear out this assertion although chemical examinations which have been made by Dr. White show very much the same ingredients present as in urinary calculi. Calculi which escape from the prostate into the bladder may undoubtedly form the nucleus of vesical calculi. Calculi which have come down from the kidney ureter or bladder and lodge within the prostate may go on to form calculi of considerable size within the prostate. These, however are of the exogenous variety and must be sharply differentiated from the endogenous calculi which we have been describing up to this point.

have been overlooked. The bladder should be also carefully searched, because prostatic calculi may escape into the bladder during prostatectomy. The inability to remove calculi within the prostatic bed at suprapubic prostatectomy has been well shown in one of our cases (BUI 4947). The importance of completely removing prostatic

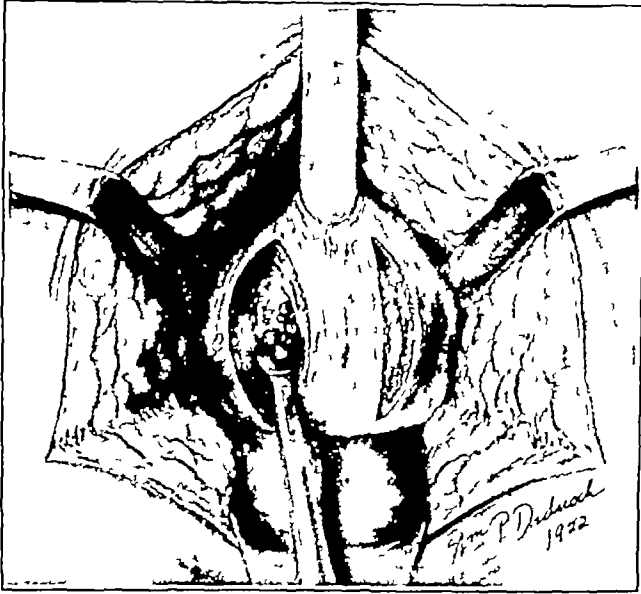


FIG 543 —Lateral capsular incisions have been made, the calculi which are found in the stratum between the lateral hypertrophied lobes and the posterior portion of the prostate being removed

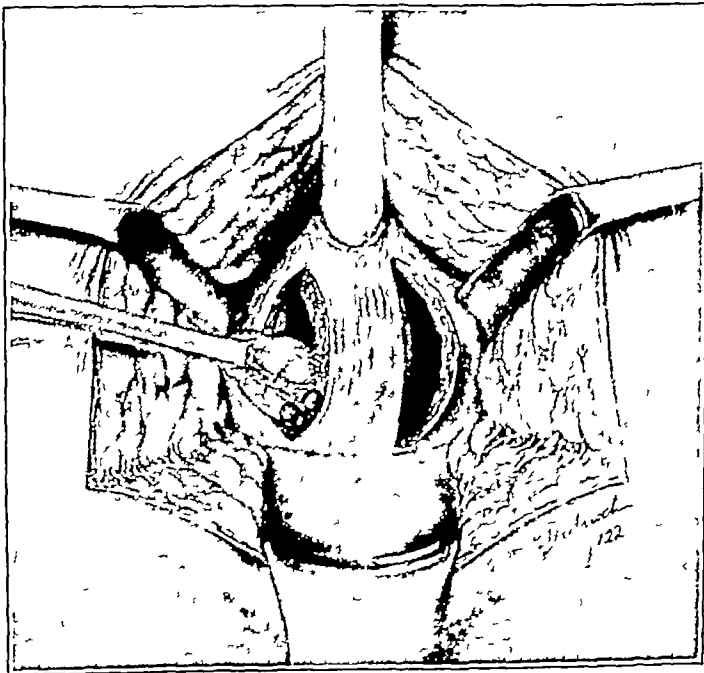


FIG 544 —The lateral lobes have been removed and the median lobe has been partially separated, exposing calculi beneath it

sudden stoppage of urine with complete inability to urinate for hours. After receiving an injection of morphine relaxation and free passage of urine occurred. On admission he was voiding freely. Suddenly complete retention of urine developed and when an attempt was made to pass a silver catheter a stone was encountered in the prostatic urethra. Applying considerable pressure the stone slipped back into the bladder where it was seen cystoscopically to be a calculus of considerable size (Fig. 14B). During the next few days the calculus was alternately in the bladder and then in the urethra where it produced obstruction until it slipped back into the bladder. It was finally removed suprapubically and a widely dilated vesical orifice and prostatic urethra discovered.

In another case a calculus was detected projecting from the utricle and verumontanum and removed with forceps through the urethroscope.

In 1 case several calculi were seen in pockets and removed by swabs.

In another following perineal prostatectomy several months previously a stone developed in the posterior urethra and was removed with my small cystoscopic rongeur.

In another case a very large calculus extended from the prostatic urethra far into the bladder. It developed first in the urethra and grew out into the bladder to become of great size.

Treatment.—The operative treatment required to remove these exogenous calculi varies according to the character and size of the calculus and the pathological conditions which accompany them as indicated in the cases cited above.

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PROSTATIC CALCULI OF EXOGENOUS TYPE

Very few cases of this type are to be found in the records of the Brady Institute, but among them there are several of great interest

In one case the patient, aged forty years, had had intermittent

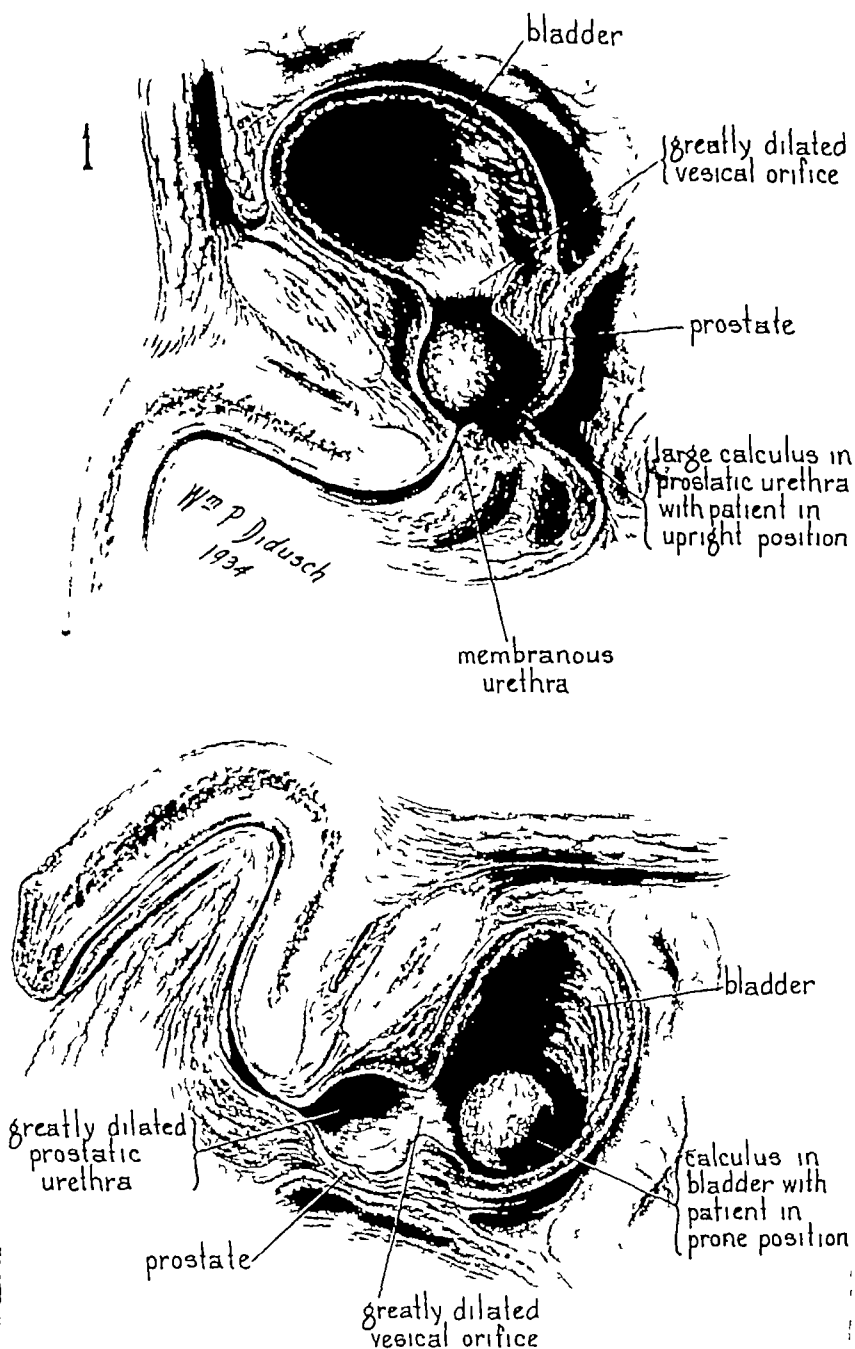


FIG 546 —Case in which calculus travelled back and forth between bladder and dilated posterior urethra 1, Calculus 2 cm in diameter in dilated posterior urethra, in which it caused complete obstruction to urination, 2, calculus in bladder after catheterization Within a few hours it was again discovered in urethra B U I 6077

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